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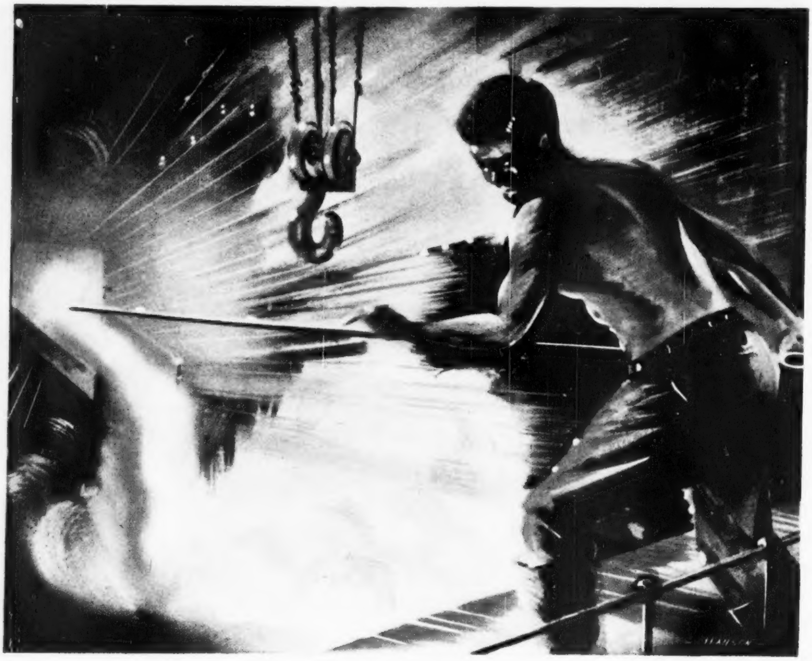

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FEATURE ARTICLES

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MISCELLANEOUS

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DICTATORSHIP?

THE backbone of the British Constitution has been a non-political Civil Service. But this grew up in the days when the Civil Service was a policy-making institution reflecting the policy decisions of the government and certainly not playing an executive rôle in industrial production.

Today, however, the Civil Service departments directly concerned with industry have increased to an unprecedented extent. The Ministry of Supply, the Board of Trade to quote but two, are examples.

Likewise, with the growth of nationalised industry, administrative workers in fuel, transport and so on find themselves as quasi-Civil Servants. They are neither fish, fowl nor good red herring! They have neither the protection of the true Civil Servant nor the responsibility of the average industrial executive. In the fuel industries the quasi-Civil Servant finds himself unable to speak even on matters technical, let alone political!

Britain was built up with a written Constitution based largely on the Four Freedoms of which freedom of speech and freedom of the press were of paramount importance. But if as nationalised industry expands the official of the nationalised industry is not free to speak, this is the first step towards dictatorship. If a man dare not express his opinion in case he will offend his boss and lose his job, it is precisely the state of affairs which the present Government, when pioneering Socialism, set out to abandon. Political victimisation was supposedly the greatest sin of Conservative England! Yet the wheels go round and evolution evolves. The common man remains unaltered and what was good for the goose is now good for the gander and we talk vaguely of progress and progressive measures! Undoubtedly this unwritten veto on Civil Servants and servants of nationalised industry from speaking their minds is the essence of dictatorship. It is being applied slowly and relentlessly in a typically Anglo-Saxon manner. Nevertheless it is very real.

There are many who would have more nationalisation of the present kind which means in turn that more people will have their throats successfully held. It is vicious in its practice although it was not envisaged by the pioneers who set about the reformation of industry.

That is the trouble with pioneers! They look at the "bad," they suggest the "good" which will replace it, and forget that having won their battle, when they implement the "good" many poor types will leap on to the band-waggon for very bad principles.

SCIENCE, INDUSTRY AND POLITICS

by

W. F. COXON, M.Sc., Ph.D., F.R.I.C., M.Inst.F.

AT a meeting of the British Pottery Managers' and Officials' Association, held on the 8th October, at the North Staffordshire Technical College, Dr. W. F. Coxon, director, Arrow Press Ltd. (publishers of *Gas Times*, *Industrial Finishing*, CERAMICS and *Industrial Gas*) said:

When I chose the title of this address I did not realise that it would be quite so topical as it has turned out to be! I deliberately selected the title because Britain finds itself at the parting of the ways—for politically and economically we are in danger of coolly and deliberately pulling down the past, good, bad and indifferent and erecting something new in its place which is the great unknown. In this transition both science and politics must react upon industry to its advantage, for industry is the only thing which pays all our bills.

Some Definitions

It is always as well to begin by some definitions, and for my purposes I am taking science as meaning the study of systematic and formulated knowledge which of necessity must be objective in its conclusions. The true scientist tries hard, or should try hard, to regulate his subjective beliefs and become judicial, seeking the truth, the whole truth and nothing but the truth, to his own individual belief, as dictated by his knowledge of scientific method. Alas, although many scientists would have us believe that they operate on this basis, the moment they tread from their laboratories into the world they must perforce temper their scientific method to the environment in which their job places them, and as such they are no longer scientists, but ordinary people doing ordinary jobs and subject to the ordinary hypocrisy which afflicts us all to a greater or lesser extent.

Industry, from my definition, is a branch of trade, and in its broadest sense I view it as the application of labour and raw materials to produce a commodity, the value of which exceeds the value of the original raw material and the labour which is incorporated therein. Whether, as the Marxist would say, this difference is called surplus value or whether it is called profit is beside the point. The main point, however, is that industry must produce a greater value than it uses for it is only industry which keeps the non-productive members of the community fed, housed and clothed.

By politics I refer to the strife of parties which today has become more or less that between those supporting the Labour cause and those supporting the Conservatives.

Politics in Industry

Immediately, the close connection between politics and industry is realised, for the Labour Party wishes for the maximum amount of State control in industry whilst the Conservative wishes to leave as much as possible of industry outside the State octopus. And here I talk in terms of productive industry where raw materials and labour are used and not so much the service industries, like the Post Office, etc. The change today is that the Government which in the past reserved itself to policy decisions on industry, is now moving into the field by becoming executive managers of a large proportion of industry and herein lies what has undoubtedly been a social revolution.

The danger of this is that productive industry, our life-blood, has now become the pawn on the economic chess board; forever open to political check. No politician or scientist would dispute that industry alone earns practically the whole of our national subsistence. It creates the wealth which

keeps itself and its employees together with the whole gamut of the Welfare State, it keeps the King on his throne, the peasant in the field, and the old age pensioner when his days of work are done. It produces the funds so liberally dispensed in the House of Commons.

Varying Approach

So, as far as Britain is concerned, industry stands out as the thing which produces our wealth whilst science and politics are the best two important ancillaries. Being quite dispassionate therefore, science and politics must work for the benefit of industry for if either reduces the margin between labour and materials produced and the value ultimately obtained, they are reducing the efficiency of industry and in the end cannot help but reduce our standard of living. Let us, therefore, examine the manner in which the politician and the scientist approaches industry.

The politician has an end, and broadly speaking the Labour Party believes in a levelling down of incomes, which ultimately means a narrowing of the gulf between the factory manager and the factory worker. This is the end to which they pledge themselves and the means they adopt towards this is the framing of policies which will attract the maximum votes at any general election. They firmly believe that security to the mass will produce a favourable reaction upon work output, but those of us who have had a close connection with labour in the mass realise that in effect this is not true, since extra effort does not bring in extra spending power. There is a tendency in every factory for the slowest or laziest worker to set the pace for the rest; herein lies the essential difference between Britain and America. We value our leisure more than hard work to earn higher wages, to buy a car or refrigerator, or a house, or what you will.

Conflicting Conclusions

The scientist we will suppose, starts off as a student of systematic and formulated knowledge. Presumably any scientist examining the position of Britain's housing by this scientific method would arrive at a similar conclusion, assuming them to be equally sincere and equally able. Yet, indeed, the conclusions arrived at by research workers for the Labour Party and the Conservative Party are, to say the least of it, somewhat conflicting. Once the scientist gets out into the world he finds himself like everyone else in the position of finding out and producing the results his master wants.

The politician is in the show business for even without a nodding acquaintance of anything, he will speak with authority upon it. His electorate do not expect him to be honest as an individual, answering a question on an unstudied subject by a confession of a lack of knowledge.

Browsing through Hansard you will find that M.P.'s solve the problem of transmuting lead into gold, they discover and re-discover the elixir of life, they propound new scientific laws with a wave of the hand and in any two days an M.P. will speak with authority on Persia, peanuts, petroleum, psychology, production or privilege. He will pass as a Crown Minister from food to fuel to trade to finance with the fluttering inconsequence of a gaudily bedecked butterfly which will die tomorrow.

Yet it is always industry which is the prime mover, the money spinner and the nation's welfare provider. The politician can be of the untrained mind, offering more and more benefits provided by industry to more and more people, and always having the magician's wishful hope that if he has rigged the stage right the rabbit will always come out of the hat.

A Degree in Science

The politician is the shrewd man for now he has embraced the scientist to his side. He has built him up as a great figure so that the man in the street now views any white-coated body in the laboratory who never gets above a test tube mixer or looker at steam recorders, as a scientist. His fellow man endows him with the clothes of a witch doctor and he basks there in this reflected glory. You can be a scientist by going to Eton and Oxford, or from Muddlecombe secondary school to London University. You might go to work and in the evenings go to the technical college and still get a degree. But, more or less, your teachers are stereotyped and the

examination you take in the end is approximately the same with the same paper qualification.

Some science students assume that this degree is in itself in the nature of a passport to greater things in its own right. Others realise that it is something to put on the shelf and then get to the serious business of earning a livelihood.

Yet university teachers who often only have their own degree, tend to persuade students that this is the end in itself for this is the only end for themselves.

This is my major criticism of science education, namely it divorces the student from the practice of science and encourages him to believe that theoretical science is more important than it really is.

One of the Mass

After all, the employer employs a scientist, looking at his degree as a means to the ends of a higher profit.

Today the science graduate finds all kinds of bodies such as the research associations, large industrial groups, the scientific Civil Service and even the politicians themselves dangling bigger and better carrots in front of his appropriate mind. Generally he goes to the highest bidder viewing himself like the girl who won the local beauty prize. But once hooked he finds that he is merely one of a mass of so-called scientists who are bought and sold on the commercial market in the same way as labour.

Soon the scientist finds out that although he has studied systematic and formulated knowledge he has become a tiny cog in a gigantic machine, and if he uses his science to show that his master is wrong, he receives the same treatment as any other poor stooge. The politician sets about controlling industry by bribe-like wage rate offers which command votes. The scientist is often employed directly, or his vanity is so played upon by letting him sit at a luncheon top-table—and even speak, that he becomes unwittingly one of these vote catchers. Of course in politics there is so often a premium upon chicanery and a taboo upon sincerity, and so in modern science there is a taboo upon that scientific method which gives the wrong answer for the sponsor's cause.

This point can be driven home very forcibly from a discussion of the most recent report of the Department of Scientific and Industrial Research. This department is paid for by industry directly, and indirectly anyway. It is supposed to work in close harmony with industry.

Since 1945 when the present Government came to power, surely fuel, or its absence, has been the thing which one would have expected to have harnessed the abilities of a large proportion of the workers in the Department of Scientific and Industrial Research. Yet just glance through their last published report.

A large amount of effort has been made to discover the constitution of coal—note, not get more coal, but to find out the constitution of that which we have. They have played about in the laboratory with the complete gasification of coal, but it has not extended beyond the laboratory. Although Germany by 1939 was producing chemicals from coal on an extended scale, the D.S.I.R. have only got to the stage of pilot plants to produce 30 gallons a day of something. Much work has been done in sampling dust in flue gases and on the grindability of coal. They tell us that now in 130 different areas using 700 instruments of various types they will tell us how much the atmosphere is polluted.

In short the Fuel Research Department of the D.S.I.R. has done practically nothing on their own admittance to get us one single ton of coal in excess of what we have.

Versatile Scientists

But is this surprising, for as secretary of the Department of Scientific and Industrial Research we have no less a person than Sir Ben Lockspeiser. Here, indeed, is a most versatile scientist. Many years he spent at the Royal Aircraft Establishment, Farnborough, working upon aerodynamics. The war brought him to be a director of Scientific Research at the Ministry of Aircraft Production and then the secretary of the D.S.I.R. which is about the plum job in State science.

Since Sir Ben Lockspeiser became secretary of the D.S.I.R. I have heard him speak with authority upon such subjects as fuel, the possible aid by the

biologists to engineering design, gas turbines, non-ferrous metals and building research, which is a pretty good chunk of knowledge for anyone. I feel sure that if occasion were to arise, Sir Ben Lockspeiser, with an address carefully prepared by the Director of the British Ceramic Research Association, would speak eventually with equal authority on pottery.

Stagnation in Building Industry

At the Building Research Congress recently, he said: "The building industry is now unwilling or unable to learn, and the picture of the industry is one of relative stagnation." Here is a State scientist, talking pure politics. He uses the politician's approach of setting up his own Aunt Sally, then proceeding to knock it down. Yet he forgets that Aneurin Bevan when he was the Health Minister, and later Dr. Edith Summerskill when she was doing his job, pointed out the wonderful achievements in building houses in Britain where our progress was described as second only to Scandinavia. Yet Sir Ben forgets that these houses were built by the stagnating building industry. He overlooks that something like half-a-million pounds per annum is spent by industry on his Building Research Station. But what does he want to do to improve the industry—he suggests the safety factors in our buildings are too high—a rather dangerous statement, and he wants a scientific attack upon the building problem by the aid of his scientists who are prepared to go into the industry and put it right. And then comes a quaint statement for a scientist that "only an artist can control the machine."

Of course he overlooks the one basic problem of British building, namely, climate. Over here you can paint the outside of buildings succesfully for about two months in the year and continuous employment in the building industry has always been a difficult one. You can keep a man on the job when he has no work and cause prices to rise unduly or you can put him off when the weather is bad. Both have their disadvantages but does Sir Ben think that his own men of science can alter the weather conditions in Britain?

Here is a scientist talking politics to the advantage of the political party in power at the time of his speech. Surely it confirms that often scientists and particularly the Government appointed scientists, must frequently be considered no longer as a scientist but as a political partisan.

Underground Gasification

Often in the pre-war days the scientist was used with his laboratory as a show piece by the managing director who, without any knowledge of the laboratory, used it to bolster his product. Today the Government is using science and research for precisely the same purpose. When someone cut a tiny hole in the ground of Yorkshire with the object of conducting some preliminary experiments on the underground gasification of coal this simple experiment was considered to be worth a press conference. The then Minister of Fuel and Power, Mr. Gaitskell, used the experiment in his speeches to show how on top of the job where his Ministry and what they were going to do. Four years have elapsed since then and Dr. Roxbee Cox, the Chief Scientist of Mr. Gaitskell's Ministry, tells us we must not look to the underground gasification as yielding exceptional results, and a recent Commonwealth specialist conference on fuel research decided that time is not yet ripe for undertaking further large-scale experimental work on underground gasification within the Commonwealth.

The experiment served its purpose, directed a little publicity at the Ministry to its advantage, but there will be no press conference to say that the whole scheme was a washout. These instances can be multiplied over and over again and it is true to say that the scientist employed by the Government must reflect the policy of the Government of the day or get out and find another job.

He has, of course, one string left to his bow. He need not bother to engage upon development work which will affect the Government, but can spend a lot of time and money examining the constitution of coal or of clay. He can build up a wonderful story about how useful this will be when it is applied, but by that time he will

have retired and his pension will be safe. And so it is if one examines critically the report of the Department of Scientific and Industrial Research. One finds that the various directors of research have discovered that fundamental research pays, it keeps their hands clean, they do not get involved in politics, they keep their job and everyone is happy except the industrial sponsor who is looking for a really realistic contribution for the vast sum he spends.

Political Patronage

Originally this lecture was to discourse upon science, industry and politics. Of the three, only industry and the men and women working in productive industry are, to use a Shinwellism, worth a tinker's cuss by comparison with the others. Politics has now entered a phase where the politician has jobs to offer on a part time basis at £500 a year to full time appointments at £12,000 a year. The present Government has instituted a scheme of political patronage which is a precedent in our political history.

The old system, whereby a man got a job because he was a husband or a brother, was bad, but at least in private industry one has to make a profit or go broke. Now if you follow the party line you get remuneration greatly in excess of your abilities and real earning power for telling the right story to the right people at the right time.

The industrialist, by which I mean the man who has direct responsibilty for running a factory commercially and technically, has been content in the past to let the financier rule him. Now he is content to let the politician rule him. The politician has built up the scientist and is using him to rule industry.

Yet the middle-class industrialist is still the key man to the set up. The Federation of British Industries did not put up that struggle and fight which they ought to have done when the nationalisers started. And what a little fight can do is shown by the success of Lord Lyle with his "Mr. Cube." He won out successfully.

The position then is quite clear. The industrialist and industrial production matter. The politician and particularly he who favours more nationalisation and more patronage does not. The scientist who has sold his science for a mess of pottage and a Government appointment matters even less.

But the question is: how much longer are the men in industry, both employees and employers, prepared to sit back and watch a crowd of untrained minds in the Trade Union hierarchy and Whitehall driving them slowly on to the rocks of technical and industrial bankruptcy?

In politics the politician should define policy. Industry has its job to do which is to produce that commodity which it sets out to produce as efficiently as it possibly can, and to attract workers to that industry. The scientist has the job of helping industry to produce more efficiently and solving those problems which industry demands, for industry pays the bill. It is no good the scientist rushing off and conducting a series of experiments and expecting industry to seize them, for they might not be the experiments that really matter. The scientist, the true scientist, has nothing to do with politics for that is unscientific in the extreme and pure emotional stimulus. But as we stand at present there is one useful entity, namely industrial production which is attempting to progress whilst carrying now not only the feeble-minded politician but also the scientist.

We used to laugh at America with its Tammany Hall where the civil servants changed with a change of Government.

Yet by all the Nationalisation Acts the chief appointments are by the Minister . . . in fact political appointments. These in turn appoint their chief scientists and other high executives.

If the Minister's Party lose an election what happens to his political appointments? Believe me there will be weeping and wailing in Hobart House, in Gas Industry House, in the railway offices and on the grid if the 25th October becomes the end of an era!

But lastly industry is made up of managers and men. When will industrial management and men realise their strength and demand a proportionate share in the government of the nation?

FLUXES FOR CERAMIC BODIES

(SPECIALLY CONTRIBUTED)

THE purpose of fluxes in the ceramic industries is to produce glassy substances which set on cooling to bind together the refractory grains of a body, or, in the case of a glaze, produce a smooth gloss covering the biscuit body. In this article we shall deal with felspar, nepheline syenite, talc, and certain lithium compounds as used in the preparation of pottery and wall tile bodies.

Felspars

These are widely distributed minerals which, outside Great Britain, are probably the most widely used of the ceramic fluxes. There are three main types of spar

Arthoclase, microcline or potash felspar, $K_2O\ Al_2O_3\ 6SiO_2$;

Albite or soda spar $Na_2O\ Al_2O_3\ 6SiO_2$;

Anarthite or lime spar $CaO\ Al_2O_3\ 2SiO_2$.

In practice none of these are found in a pure state, and potash spar usually contains soda spar, and soda spar lime spar. Potash felspar is the one most used in the ceramic industries. It is widely distributed over N. America, Norway, Sweden, Italy and Russia and is the most common mineral in crystalline rocks. The colours range from white, cream, or pink to milky, red, brown, grey and green. The specific gravities of the three types of spars vary slightly; for potash spar the value is 2·56, for soda spar 2·60 (albite) and for anorthite it is 2·76. Albite is the most fusible (1,110° C.) and anorthite the least (M. Pt. 1,532° C.). Felspars are the most widely distributed components of crystalline rocks, and make up about 60 per cent. of the igneous rocks. For practical purposes the workable deposits are the granite pegmatites—large dykes of coarsely crystalline material which lend themselves to hand sorting. As already mentioned the felspars never occur pure, and potash felspar contains some soda spar. In addition quartz, white and black mica, garnet, beryl, and tourmaline are present as impurities. These are removed as far as possible, especially those containing iron such as biotite, garnet, and tourmaline.

Purification of Felspar by Flotation

In recent years a method of purifying felspars from quartz by froth flotation and table agglomeration has been described (cf. R. G. O'Meara, J. E. Norman, and W. E. Hammond, *Bull. Amer., Ceram. Soc.* **18,** 286 1939). The powdered felspar was removed as a froth using a bath containing auryl amine hydrochloride and fluorine-containing acids or salts were used in an acid bath to prevent the quartz floating. Recoveries of felspar as high as 96-98 per cent. have been obtained and the quartz tailing contained only small amounts of felspar as impurity. On re-treatment this tailing was found to contain over 99 per cent. quartz.

Specifications for Felspar

The preparation of an acceptable standard specification for felspar has been discussed in the United States. The matter is one of some difficulty owing to the nature of the production, and any specification which tends to be too rigid would be unworkable. The American National Bureau of Standards published a commercial standard CS-23-30 in 1930, but as may be expected from the complexity of the problem, this did little beyond classify felspars according to alkali content and fineness of grinding. The fineness classification was based on the percentage remaining on the standard 200 sieve, and that remaining on the sieve designated.

As an example an 140 sieve product was classified as having 2·5-5·0 per

cent. residue on a 200 sieve, and less than 1 per cent. on the 140 sieve. Based on alkali content, the spars were divided into Group 1 with less than 4 per cent. Na_2O—suitable for ceramic bodies; Group 2 containing 4 per cent. or more of Na_2O and suitable for glazes; and Group 3 suitable for glass making, where silica, alumina and iron content are specified. The method of carrying out the sieve lists and analysis are specified. A further specification published in 1935 by the National Feldspar Association (U.S.A.) based the classification primarily on use. The alkali ratio clauses were dispensed with, and the silica tolerance was raised to 3 per cent. According to R. W. Metcalf (*Quarry Manager J.* 24, 262, 1941-2) felspar is classified as glass spar, pottery spar, and glaze spar.

In glass making the spar is used primarily as a source of alumina and the type of spar (soda or potash) is not important. The type of spar is classified according to values of per cent. SiO_2, per cent. Al_2O_3, and per cent. iron (Fe_2O_3), e.g. 67-16-x represents 66-67·99 per cent. SiO_2—16·00-16·99 per cent. Al_2O_3 and not more than 0·15 per cent. Fe_2O_3. Minimum total alkali is 11·5 per cent. Lime is usually less than 2 per cent.

Pottery spar is usually mainly potash spar and is classified on percentage silica and ratio of Na_2O to K_2O. SiO_2 usually ranges from 73-65 per cent., K_2O from 12·5-3·5 per cent., Na_2O from 1·5-6·5 per cent. and 0·1-0·05 per cent. Fe_2O_3.

Glaze spar is classified as high soda spar and must contain 4 per cent. or more of Na_2O. Thus No. 4 glaze spar contains 4-4·99 per cent. Na_2O and No. 8 glaze spar 8·00-8·99 per cent. Na_2O. In testing spar for use in pottery bodies, provided the chemical analysis is satisfactory, most potters will simply make a slab of the ground material and fire it in the biscuit oven. It should produce a smooth glassy surface free from craters, and be of a good white colour.

In this country felspar is usually ground by the potter in ball mills. As grinding proceeds the liquid becomes alkaline and care must be taken to prevent setting on standing. The rôle of the felspar in bodies is to react with the other body materials to form a glassy substance and not a simple melting and solution process (cf. E. Schromm and F. P. Hall, *J. Amer. Ceram. Soc.* **19,** 159, 1936). According to these authors the quantity of glass in a fired true porcelain body is normally two-and-a-half times the quantity of felspar used. Where it is not necessary to produce a completely vitreous body it may suffice to merely produce sintering at the edges of the body particles. In this case less flux is added to the body.

The formation of glassy material is also closely bound up with the translucency developed by certain vitreous bodies such as bone china and porcelain, and the late Dr. J. W. Mellor considered that just as paper can become translucent by oil or grease permeating the spaces between the cellulose fibres, so the penetration of glassy material into the pottery body structure could also bring about this desirable property.

As illustrations of the difference in amounts of felspar used in vitreous and non-vitreous bodies we have the following recipes:

	Wall tile body (porous)	*Vitreous earthenware body*
Ball clay	25	22
China clay	25	22
Flint	40	30
Cornish stone	10	15
Felspar	—	11

Again the fluxing effect of felspar is seen in the increase in the firing temperature on progressively reducing the amount of it in a porcelain body.

Final firing temp. °C.	1,200	1,250	1,320	1,410
Seger cone	6	9	11	14
% China clay	25	25	35	48
% Quartz	10	40	40	30
% Felspar	65	35	25	22

Effect of Felspar Composition on Whiteware Bodies

The effect of the composition of felspars used in American whiteware bodies has been the subject of more than one investigation. Thus

R. F. Geller and A. S. Creamer (*J. Amer. Ceram. Soc.* **14,** 30, 1931) stated that with a vitreous body the type of felspar used had no discernible effect on the firing behaviour of the body or on the colour. Translucency increased with increasing K_2O content of the spar. Mechanical strength was influenced more by heat treatment than by the kind of felspar used, and no measureable difference in elasticity was noted as a result of changing the kind of spar. The use of high soda spars gives bodies of higher thermal expansion.

Eutectic Formation

The possibility of eutectic formation between the types of felspar commonly found or between felspar and other body components should have an influence on the behaviour of felspar in ceramic bodies. Conflicting reports have been made on the possibility of eutectics between felspar and flint and J. W. Mellor (*Trans. Brit. Ceram. Soc.* **4,** 49, 1904-5) reported a eutectic of 75 per cent. felspar and 25 per cent. flint. Simonies (Sprechsaal No. 30, 1907) did not substantiate this.

Other investigators have given conflicting reports on this problem. A later investigation by C. R. Amberg and J. L. Gallop (*J. Amer. Ceram. Soc.* **14,** 733, 1931) on the melting point relationship of potash felspar, soda felspar and flint showed no eutectics in either binary series of flint and felspar. J H. Chilcote (*ibid.* **17,** 203, 1934) showed that a ternary eutectic existed of 60 per cent. albite, 30 per cent. microcline and 10 per cent. andesine. He studied the effect of mixtures of these spars in a standard vitreous white body of 20 per cent. ball clay, 30 per cent. kaolin, 30 per cent. flint and 20 per cent. felspar, and showed that the body containing the ternary eutectic was more vitreous and stronger, and also developed a higher translucency at lower temperatures. As was to be expected this composition was also most prone to warping on firing.

The substitution of soda spar for potash spar in whiteware bodies has been investigated by G. A. Loomis and R. A. Blackburn (*ibid.* **29,** 48, 1946), who have shown that soda spar is a more vigorous flux, and that in vitreous bodies the amount of it required is less than for potash spar to give the same amount of vitrification. For semi-vitreous bodies soda spar can replace potash spar in amounts up to about 12 per cent. without significant change on the body except possibly in crazing resistance. From a practical point of view it seems therefore that eutectic formation, on the evidence produced to date is not an important feature in the formation of glassy material in the bodies commonly in use today.

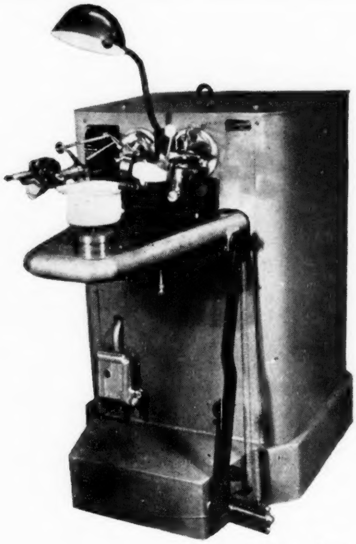
Cornish Stone

In this country Cornish stone is widely used in place of felspar as a principal body flux because good deposits of felspar are not available here. This occurs in the Cornish granite mass and may be regarded as an altered granite containing felspar, quartz and china clay. The amount of clay is variable and for simplicity stone can be regarded as an intermediate stage in the change from granite to china clay. It will be recalled that the material was discovered by William Cookworthy in his search for the pe-tun-se and kaolin used by the Chinese for the manufacture of hard porcelain. In addition to felspar, quartz and clay, Cornish stone contains other minerals such as white mica, tourmaline, topaz and fluorspar. The latter is often coloured purple with traces of manganese dioxide and gives the coloured flakes so characteristic of "purple stone." The principal deposits are around St. Austell in Cornwall. It is extracted simply by quarrying, and the material is hand sorted into the following grades:

(a) hard purple;
(b) mild purple;
(c) dry white;
(d) buff stone.

Sorting the stone calls for a certain amount of skill, and shortage of labour for the china stone quarries is a problem in the industry at the present time.

Buff stone is contaminated with iron and not suitable for use in whiteware bodies. Hard purple is the most fusible stone, dry white the least, this being due to the fact that the dry white stone contains greater amounts of refractory china clay. Hard purple stone in this case is physically harder than the other kinds. It is the most



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valuable type of stone. Mild purple stone contains less felspar than the hard purple and has undergone more decomposition. It is often of a greenish tinge. Dry white is more friable and contains greater amounts of china clay. Nowadays mixtures of the different kinds of stone are used to give the required fluxing. The material is ground in ball mills to approximately 60 per cent. less than 0·01 m.m. in diameter and, as with felspar, the slurry becomes alkaline and "antisets" have to be added.

Analyses of Stone

Typical analyses of varieties of stone are given in Table 1.

Routine tests on the stone are similar to those for felspar. The grain size is checked and a sample of the stone is fired in a biscuit oven. It should fuse to a glossy surface free from blisters and be a good white colour. Stone that blisters in this test is not favoured, the view being held that it may behave similarly in the biscuit fire.

Typical body recipes using Cornish stone are given in Table 2.

Bodies Maturing at Lower Temperatures

A research problem which has come to the fore in recent years is the search for bodies which can be fired at lower temperature without loss of desirable physical properties such as strength, translucency, etc. The increasing cost of firing gives added importance to this work.

In N. America the possibilities of using nepheline syenite as a principal flux have been investigated. This is a crystalline igneous rock resembling granite in texture containing nepheline (K_2O $3Na_2O$ $4Al_2O_3$ $9SiO_2$) microcline (potash felspar), albite (soda spar) and with mica, hornblende and magnetite as accessory minerals. It occurs in various parts of N. America, and in India and Russia. It contains no free quartz. A typical analysis (cf. *Ceramic Industry*, January, 1951) is:

SiO_2	60·22%
Al_2O_3	23·72%
Fe_2O_3	0·06%
CaO	0·42%
MaO	0·09%
Na_2O	10·06%
K_2O	5·04%
Ignition loss	0·47%

This analysis was done on a sample after removing about 2 per cent. iron from the original rock.

Nepheline Syenite, a Powerful Flux

On account of its high alkali content nepheline syenite is a powerful flux, and investigations have shown that it is possible to replace felspar with it and produce bodies maturing at lower temperatures (cf. C. J. Koenig, Nepheline syenite in Hotel Chinaware Bodies —*J. Amer. Ceram. Soc.* **25,** 90, 1942; Use of Syenite in Semi-vitreous Ware, *ibid.* **19,** 295, 1936; Use of Nepheline Syenite in Floor and Wall Tile Bodies, *ibid.* **23,** 86, 1940; Use of Nepheline Syenite in Sanitary Porcelain, *ibid.* **22,** 38, 1939).

TABLE 1.

(Mellor, *Trans. Brit. Ceram. Soc.* **12,** 151-9, 1912-13)

	Dry white	*Purple*	*Mixed stone*
SiO_2	73·96	70·31	72·15
TiO_2	0·28	0·17	0·20
Al_2O_3	15·9	16·62	16·28
Fe_2O_3	1·40	1·50	1·45
MgO	0·32	0·08	0·20
CaO	1·89	1·50	1·65
K_2O	4·34	5·69	5·01
Na_2O	0·45	2·62	1·50
Loss on ignition	1·11	1·25	1·15

TABLE 2.

Bone china	*Earthenware*	*Vitreous earthenware*
Bone ash 50%	Ball clay 25%	Ball clay 22%
China clay 25%	China clay 25%	China clay 22%
Stone 25%	Flint 35%	Flint 30%
	Stone 15%	Stone 15%
		Felspar 11%

The use of nepheline syenite is also stated to increase the firing range giving less losses from warping. In semi-vitreous bodies it confers higher expansion on the body, which in turn promotes crazing resistance.

According to *Ceramic Industry* (loc. cit.) low temperature vitreous bodies maturing at Orton cone 3-5 (1,145°-1,180° C.) can be made from clays and nepheline syenite. These have long firing range, and are strong and highly translucent when prepared by wet milling. An example is given as:

Nepheline syenite	54%
Flint	6%
Kaolin	24%
Ball clay	16%

Its use is also recommended in glass batches and for vitreous enamels.

An example of a vitreous sanitary-ware body is:

Ball clay	26%
English china clay	26%
Nepheline syenite	22%
Flint	26%

This is fired at Orton Cone 10 (1,260° C.). For floor tiles the following body matures at Orton Cone 8 (1,225° C.) (cf. *Ceramic Industry* loc. cit.):

Nepheline syenite	62%
Kaolin	9%
English china clay	10%
Plastic kaolin	14%
Flint	5%

Unfortunately this mineral is not found in this country and the cost of importing it from dollar countries has not hitherto encouraged its use on a large scale.

Use of Talc

Talc, a hydrous magnesium silicate, usually described as 3MgO $4SiO_2$ H_2O (in some talcs the ratio is 4 : 5) is used in some bodies in the U.S.A., the MgO acting as a flux. It imparts thermal shock resistance to bodies due to the formation of cordierite and millite on firing, and in electrical insulators it imparts high resistance, low dielectric loss and low power factor. In pottery bodies and wall tiles one

of the most important effects which arise from its use is the decrease in moisture expansion of porous bodies thereby giving increased resistance to delayed crazing. In whiteware bodies talc has been used to replace some of the felspar. For this purpose lime bearing talc is better than the lime-free variety.

One recipe given in *Ceramic Industry* (loc. cit.) for a dinner ware body of the talc type uses a mixture of two ball clays, china clay, spar, flint whiting and talc. The talc amounts to 37 per cent., felspar 8 per cent., whiting 7 per cent., flint 8 per cent., china clay 11 per cent. and the ball clays together account for the rest. This body is fired to Cone 01-1 (890°-1,125° C.).

Lime-bearing Talc Used in Wall Tiles

In wall tiles the lime-bearing talc is used. It is employed either without felspar, in which case the percentage talc is high, or in amounts up to about 10 per cent. with additions of felspar. Such bodies have low moisture expansions and are thus resistant to delayed crazing.

On account of the small firing range when the talc content approximates to that of the clays the percentage talc used must be considerably higher or lower than that for clay in the body. Where no felspar is used the talc content must be high to obtain the necessary body contraction to keep the glaze in compression (to avoid crazing), and also to obtain the necessary densification (cf. E. Rosenthal, *Pottery and Ceramics*, Penguin Books, 1949).

The same author (p. 224) gives the following example of a high talc body described by Prof. McNamara (Pennsylvania State College).

Talc	38%
Ball clay	22%
Kaolin	6%
Flint	34%

Examples are to be found in the literature of talc bodies with over 60 per cent. of talc.

An example of a low talc wall tile body is:

Ball clay	29·1
Kaolin	25·2
Flint	31·5
Felspar	6·0
Talc	4·0

(H. Z. Schofield, *Bull. Amer. Ceram. Soc.* **16,** 203, 1937.)

Lithium Minerals are Powerful Fluxes

Finally it should be noted that lithium bearing minerals form low melting systems with felspars, and this fact has been used in the preparation of low maturing bodies. Lepidolite, a lithium alumina fluosilicate has been investigated as a body flux in the U.S.A.

Containing two very powerful fluxes lithia and fluorine, this material offers possibilities for the preparation of low maturing bodies. J. W. Donahey and J. D. Clark (*Ceramic Industry* p. 74, November, 1949) have published a résumé of the literature on its use as a ceramic flux, and have also described experiments on semi-vitreous and vitreous bodies where it has been used as a flux in combination with felspar, or with nepheline syenite.

The first series of experiments were carried out on a semi-vitreous dinner ware body compounded of flint 33·33 per cent., felspar 12·0 per cent. and a mixture of clays. By replacing the felspar in part with lepidolite, and with mixtures of lepidolite, talc, and nepheline syenite a series of bodies were obtained and fired to Orton Cones 2, 4 and 6. The strengths were then compared as well as the fired shrinkage and absorption. It was found that addition of talc and the use of nepheline syenite was advantageous for low temperature bodies, and the following was suggested as a promising semi-vitreous body maturing at O. Cone 3 (1,145° C.): nepheline syenite 6·07 per cent., lepidolite 7·43 per cent., talc 1·50 per cent., flint 30·33 per cent. and the remainder a mixture of clays.

Vitreous bodies were not entirely satisfactory as zero absorption could not be reached without partial overfiring. Where ½-1 per cent. absorption is satisfactory however, the authors consider that lepidolite as a flux in mixtures similar to those described may be promising and the bodies may be satisfactory for once-fired ware. It is not considered that fluorine evolution on firing would be objectionable.

A later review (Anon. *Ceramic Industry*, March, 1950, p. 77) states that it is possible to lower the maturing

temperature of existing bodies by as much as 10 cones by using a multiple flux, increased in amount at the expense of the flint, and by milling the body. As an example a vitreous china body containing 22 per cent. felspar, 45 per cent. clay, 33 per cent. flint was virtually a cone 14 body (1,390° C.). When the body was modified to 28 per cent. flux, 27 per cent. flint and 45 per cent. clay the body matured at cone 8 (1,225° C.). The flux combination was approximately 14 per cent., lepidolite, 11 per cent. nepheline syenite and 3 per cent. talc. Table 3 shows the results obtained.

Body costs would be increased and ball milling would not be practicable in most cases, but it is considered the lower fuel costs would offset this and that further investigations on these lines should be fruitful.

TABLE 3.

	Firing temperature					
	O. Cone 2 (1,135° C.)	4 (1,165° C.)	6 (1,190° C.)	8 (1,225° C.)	10 (1,260° C.)	12 (1,310° C.)
Standard Body						
Fired strength P.S.I.	—	3,000	3,500	4,600	5,300	5,600
Absorption %	—	16·2	10·7	9·7	5·7	3·6
Plus Increased Flux Mixture						
Fired strength P.S.I.	6,300	7,000	8,400	8,500	—	—
Absorption %	4·2	3·5	0·8	0·2	—	—
Plus 24 hours Milling						
Fired strength P.S.I.	8,000	10,200	10,000	—	—	—
Absorption %	2·1	0·2	0·1	—	—	—

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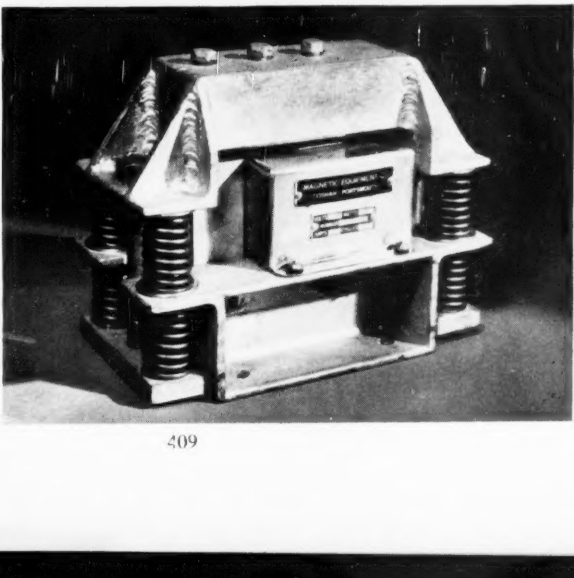
The top unit consists of a laminated armature which is attached to the vibrator body. Coupling between the two units is by liberally rated springs, and the whole system is tuned to be in resonance with the supply frequency under working conditions. By this means a powerful vibrating force is obtained with the expenditiure of a very small power consumption.

Units are provided for single-phase working, and when more than one unit is required, automatic synchronising is obtained. The degree of vibration is controlled by varying the amptitude of the armature movement by a regulator connected in the circuit, and permitting the most desirable operating conditions to be obtained. Regulators for this application can be provided as an extra.



The Magnetic Equipment Co., of Cosham, Portsmouth, "Magco" bin vibrator

DRYING TECHNIQUE

by

R. R. CLEGG, A.M.I.Mech.E., A.M.I.H.V.E.*

PART I

THE object of the present paper is to demonstrate how considerations of theory, coupled with the requirements of practice, are combined in current drying technique. A brief survey will be made also of the drying machines in common use.

There is a wide range of variation in the nature of the materials to be dried, and a correspondingly wide difference in machine layout and design. An attempt will be made to illustrate and discuss the basic designs of each group of drying equipment.

Usually, it is the physical form of the wet material which determines the way in which it must be handled in the drying machine and the physical characteristics which determine the operative conditions during that process; so that, whilst the mechanical arrangement of the machine must accommodate the former, the aerodynamical and thermal design must satisfy the latter.

In the drying process the temperature of the stock must be raised to such a degree and in such a manner that the excess moisture in the stock will be evaporated and the vapour continually removed from the system. This means, first, that heat has to be transferred from the heating medium to the stock, and secondly, that the atmosphere must be thoroughly ventilated.

There are four main types of dryers, namely contact dryers; convection dryers; vacuum dryers; radiant-heat dryers.

CONTACT DRYERS

Flat and Cylindrical Drying Surfaces

Contact dryers take the form of flat or cylindrical contact surfaces according to the characteristics of the stock.

* Tomlinsons (Rochdale) Ltd.
A major extract from a paper presented recently to the Institute of Fuel.

With the flat type the stock is usually stationary within the machine throughout the drying cycle, or is stationary while the platen surface is in contact with it. With most dryers, however, the contact surface is cylindrical and in motion.

An example of the stationary contact surface is the drying floors used in the brick and china clay industries and which are heated from below by steam pipes or flue chambers, often with the waste gases from a nearby kiln or furnace (Fig. 1).

Examples of cylindrical drying surfaces are the drying cylinders or drums used in the textile trade, in the paper-making industry, the chemical trade and certain food-preparation processes (Fig. 2).

The conditions existing on a contact surface can be considered analogous to those existing in any other form of thermal drying machine and thus may be divided into three stages:

1. The phase during which heat is given to the stock and the moisture which it contains, raising their common temperature with little or no evaporation.
2. The phase during which the bulk of the moisture is evaporated.
3. The phase during which the final moisture is evaporated, the rate of evaporation progressively diminishing and the temperature of the stock progressively increasing.

The characteristic feature of the contact dryer is that the temperature of the contact surface is above that of the ambient air and usually above the atmospheric boiling-point of water. Heat transfer between stock and air will be always in the direction from stock to air (and not, as in the case of the convection dryer, from air to stock) so that the wet-bulb temperature of the surrounding atmosphere will have no direct relationship with the temperature of the stock.

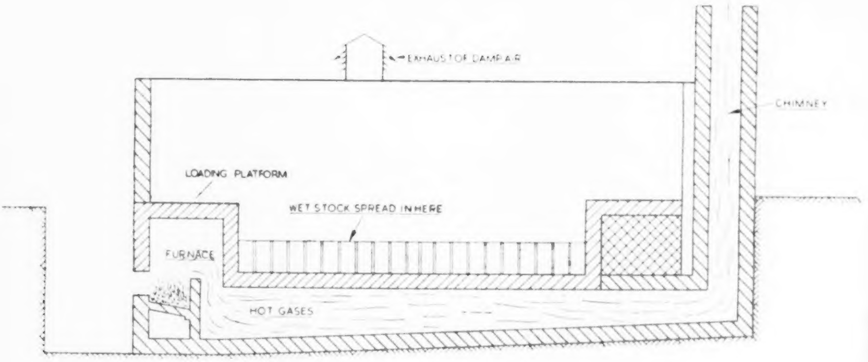


Fig. 1. Drying floor for pastes and slurries

Heat for vaporising the moisture enters the stock from that side which is in contact with the heated surface, and the vapour evolved either passes through the wet stock or emerges from the plane of contact (the latter is, however, unlikely because of the pressure exerted by the stock on the contact surface).

The series of resistance layers usually operative in practice are illustrated. Each must be considered separately if an attempt is to be made to reduce the overall resistance of the group and thus accelerate evaporation (Fig. 3).

Efforts must be made to induce turbulence of the heating mass close to the shell. The shell must have a high thermal conductivity and its surface must be clean, smooth and perfectly cylindrical.

As is shown in Fig. 4, an air stream directed on to the outer surface of the stock will help to increase the overall rate of heat transfer. The author had always considered that such an air stream would not be effective unless its temperature exceeded that of the stock surface, but recent experiments by the British Cotton Industry Research Association have shown that such may not be the case.

There are four alternatives to the use of steam as the heating medium, namely (i) high-pressure hot water, (ii) heated oil, (iii) electrical elements, (iv) direct firing. Steam has the advantage that it is more easily applied, is often available in large quantities at low

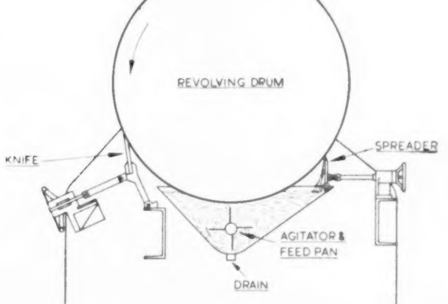


Fig. 2. Single-drum dryer with a dip feed

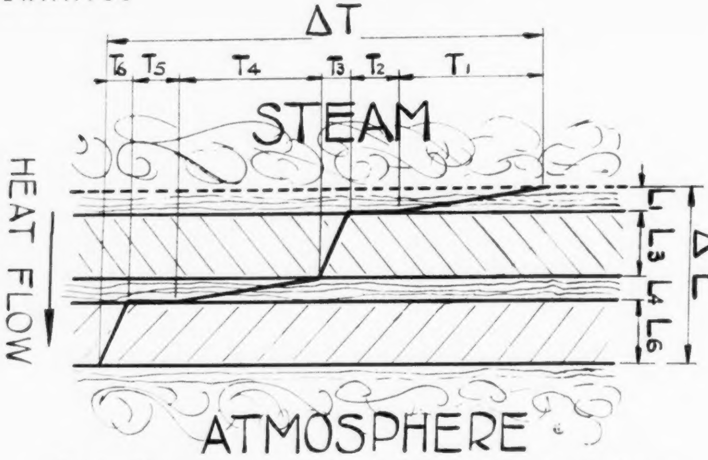


Fig. 3. Diagrammatic illustration of the series of resistance layers L_1 = thickness of fluid film, steam side. L_3 = thickness of cylinder shell. L_4 = thickness of fluid film and oxide film between face of cylinder and inside of stock. L_6 = thickness of stock. T_1 = temperature-drop through L_1. T_2 = temperature-drop at entry to cylinder shell. T_3 = temperature-drop through L_3. T_4 = temperature-drop through L_4. T_5 = temperature-drop at entry to stock. T_6 = temperature-drop through L_6. T = total temperature-drop. L = total thickness

cost as pass-out steam, and that compared with hot water or hot oil, a smaller weight is required for a specific drying duty. On the other hand, the heat transfer coefficient from water or oil to the solid shell is greater than that of the vapour to the shell, but this advantage is offset by the need to employ circulating pumps when using hot liquors. When steam is used it must be dry, saturated and free from air if the potential heating capacity, as indicated by the pressure gauge is to be realised.

Film or Roller Dryers

These machines, which are used extensively for the drying of liquids, pastes or slurries, consist of a drum on the heated surface of which the wet

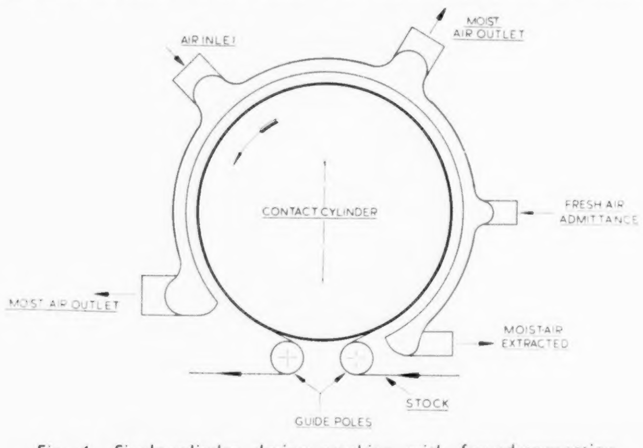


Fig. 4. Single-cylinder drying machine with forced-convection acceleration (stock contact on one side only)

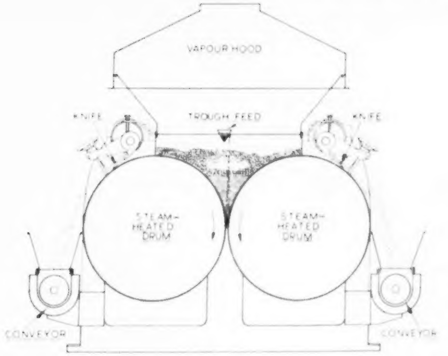


Fig. 5. Double-drum dryer with cross speed

stock is spread in a uniform layer or film. The drum is rotated at such a speed that the drying cycle is completed in less than one complete revolution, so that a continuously available drying surface is presented at the point of feed. Dependent upon whether the stock is to be completely or partially dried, the surface will be either flat and smooth or grooved and finned. The machine may be built either with a single drum or with a number of drums (see Fig. 5).

Spreading rollers for transferring the stock from a feed trough to the contact surface may be replaced by a spray feed, a dip feed (see Fig. 2) or a splash feed; or, as with a two-drum machine, the gap between the drum surfaces at the closest proximity may be the factor determining the maximum film thickness.

The dry stock is removed by scraper knives or by individual doctor blades, and leaves either in the form of flakes or granules (smooth drum surface) or partially dried sticks (grooved drum).

CONVECTION DRYERS

Convection dryers are drying machines in which a stream of moving gas (usually air) is utilised as the principal heating medium. They constitute the largest and most varied single group of drying machines, and are able to handle practically every type of stock. They therefore vary greatly in size, design and operating procedure, but all include air-circulating equipment, air-heating equipment and a stock-supporting mechanism, each of these items being suitably protected

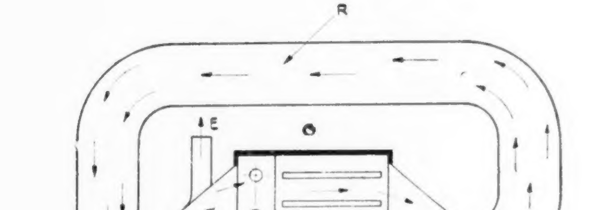


Fig. 6. The essential features of a convection dryer

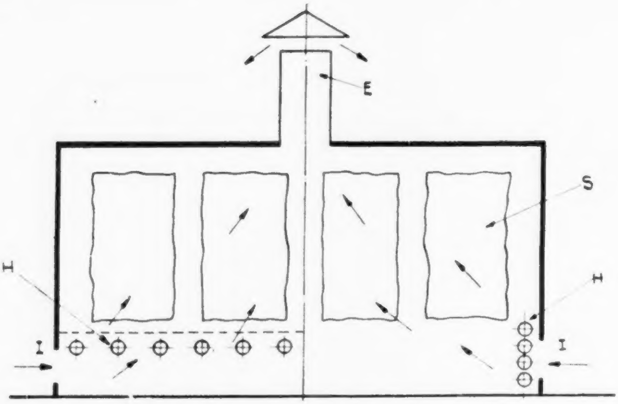


Fig. 7. Drying room with natural convection

against loss of heat by radiation. A typical convection drying machine is shown diagrammatically in Fig. 6.

The essentials in the design of a convection drying machine are: (i) to ensure uniformity of air flow in relation to the stock; (ii) to ensure the maximum rate of heat transfer, by providing as high a rate of air flow across the surface as is compatible with its physical characteristics and the operating point within the drying cycle; (iii) to ensure the optimum relationship between the temperatures registered by the wet-and-dry-bulb thermometers. In practice, it is found that a system of vigorous air recirculation will satisfy the second and third requirements but a compromise has often to be accepted with respect to the first, since the degree of uniformity in the contact between air and stock is dependent upon the shape, size and formation of the wet material. In the attempt to make this contact more intimate and uniform many different types of convection dryers have been evolved.

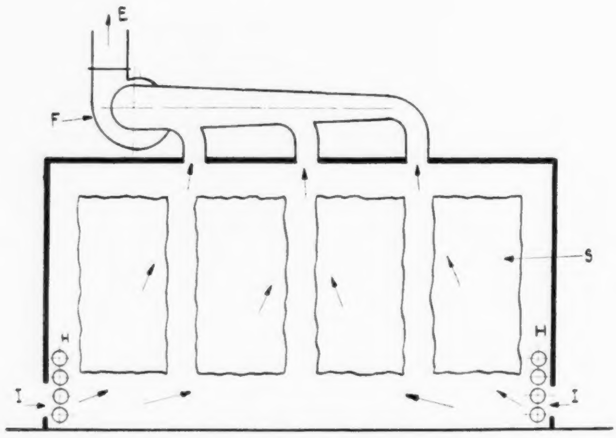


Fig. 8. Drying room with induced convection

The most elementary form of convection dryer consists of an enclosed space in which the stock is either hung or stacked and through which air is allowed to flow under the influence of natural convection. As this arrangement satisfies none of the requirements mentioned above, slow and uneven evaporation may be expected; it is found that pockets of stagnant air and vapour begin to form near which the rate of evaporation is negligible (Fig. 7). Extraction or plenum fans are sometimes introduced to control the air throughput, but frequently the expense is not justified by the resultant increase in output, since in this type of dryer much of the warm air bypasses the stock (Fig. 8).

Batch Dryers

This is probably the most popular design of convection drying machine in use today, chiefly because of its low initial cost and the ease with which it can be made to handle materials of widely different characteristics. It is a direct development from the drying room, but, unlike that arrangement, satisfies the three requirements defined under the main heading Convection Dryers.

Batch drying machines may be either single- or multi-chamber, and each chamber is fully loaded with a charge of wet material, which remains until it is dry.

In the tray or shelf type of batch dryer the stock is held in shallow horizontal containers, across, between and through which the air stream is circulated. The containers (which in this paper will be referred to as "trays") are either made of sheet material, which may or may not be perforated, or are of openwork construction. They are stacked in tiers one above the other and their depth and vertical pitch are determined by the nature of the stock. If there is a continual and a considerable diminution of the rate of diffusion as the material approaches dryness, shallow trays have to be employed. About 1 in. is an average depth when dealing with loose powders or crystals which do not coagulate during drying. For pastes and slurries—as met with in the

Fig. 9. Shelf dryer operating on the batch principle

colour trades, for example—depths of $1\frac{1}{4}$-$1\frac{1}{2}$ in. are quite common. With loose fibrous stock the tray depth can be increased to as much as 6 in.

The air circulation within the compartment may be either horizontal or vertical, according to the nature of the stock, the usual direction being horizontal. If the material is a paste or a slurry when wet, or is finely divided when dry, it will not be possible to use trays of perforated or openwork construction and therefore the air will have to be circulated across and between them. The same will apply if the loaded tray presents

Fig. 10. Tray dryer operating on the batch principle

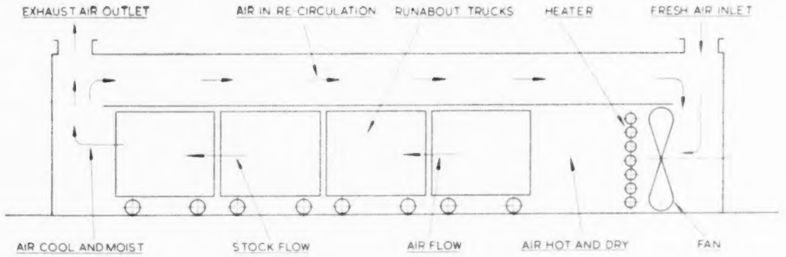


Fig. 11. Tunnel machine with run-about trucks (con-current straight through flow with recirculation)

a projected area which in plan is virtually solid, even though the base of the trays be of openwork construction; for if vertical flow were attempted powerful fans would be required and the stock from the upper trays might be entrained by the upward current of air.

When the stock is carried on "solid trays" the wet-bulb thermometer may no longer provide a direct indication of the stock temperature, since the trays shield the lower surface of the stock from direct contact with the air stream. Within the limits of the coefficient of conduction at the surface of interfacial contact, the dry-bulb reading will govern the temperature of the lower surface of the stock and will determine how much heat is radiated from the lower surface of the tray above to the upper surface of the stock in the tray below.

The decision to employ upward or downward air-flow is sometimes taken on the erroneous assumption that (*a*) the air will move upwards through the chamber by natural convection, (*b*) the moisture within the stock will gravitate towards the lower extremities. Quite apart from the fact that natural-convection effects are of little consequence in forced convection, the heating elements may be so located in relation to the wet stock and to the point of heat input that no advantage is gained from the effects of natural convection.

Further, before the stock is placed in the dryer, its moisture content should be reduced below the point of fibre saturation. In the few cases where this is not practicable, an intermittent reversal of the air-flow direction can be of advantage. With light, threadlike stock, which must of necessity be suspended within the drying compartment, downward flow will produce less entanglement of the filaments than upward.

No decision should be taken regarding the methods of supporting the trays until due consideration has been give to the conditions governing the

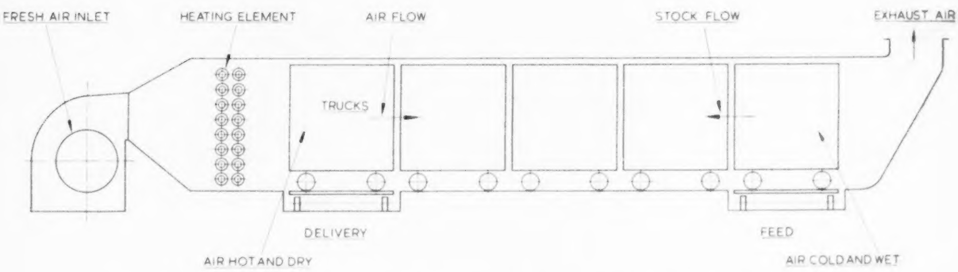


Fig. 12. Tunnel machine with run-about trucks (counter-current flow with no recirculation)

THE THREE MAIN CIRCULATING SYSTEMS AVAILABLE FOR USE IN TUNNEL-TYPE DRYING MACHINES

Circulatory system		*Temperature Conditions*		*Humidity Conditions*		
Type	*Direction*	*Air inlet*	*Air outlet*	*Air inlet*	*Air outlet*	*Remarks*
Straight through	Con-current	Unlimited	Low	Low	High	The impact of cold wet air at the dry end of the machine retards the evaporation of the final moisture content.
Straight through	Counter-current	Limited by dry stock	Low	Low	Medium to High	The low inlet temperature limits the overall evaporation but the dry air conditions at the dry end of the machine assist towards the evaporation of the final moisture content.
Straight through	Wet end — Con-current Dry end — Counter-current	Dry end — Limited by dry stock Wet end — High	Medium	Dry end — Low Wet end — High	Medium	The combination of con-current/counter-current flow combines to assist in producing conditions more closely approaching those associated with progressive recirculation than is customary with straight-through flow.
Progressive recirculation	Counter-current	Limited by dry stock condition	High	Low	High	The inter-zonal recirculation satisfies convection drying essential No. Two whilst the progressive air flow produces a condition of high thermal efficiency, with a high "wet" end temperature and humidity, both conducive to the promotion of rapid heating and evaporation.

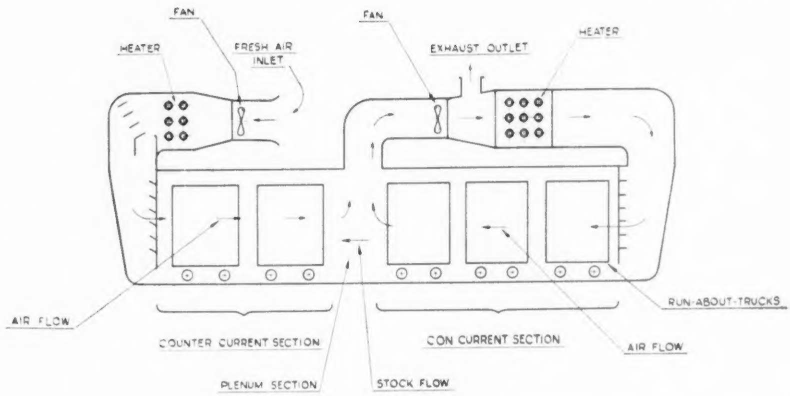


Fig. 13. Tunnel machine with run-about trucks (combined con-current and counter-current with recirculation in con-current section)

whole cycle of production. The primary aim should be to reduce to a minimum the manual effort required to operate the plant.

In the shelf dryer (Fig. 9) the tray-supporting members are built-in as part of the structure of the dryer. Each tray has to be inserted and removed separately, but the trays can be brought to and transported from the chamber in bulk on trucks.

In the tray dryer (Fig. 10) the sliding trays carrying the wet stock are loaded on to a truck which is then wheeled into the drying compartment, where it remains until the drying cycle is completed. Such an arrangement ensures that full use is made of the total effective drying time and often eliminates double handling of the stock. Other advantages are (*a*) uniformity of loading, (*b*) balanced air circulation, (*c*) ease and rapidity of recharging and (*d*) vertical air-flow through the chamber.

Tunnel Dryers

For high rates of output the multi-chamber batch dryer is uneconomical to operate and instead a tunnel dryer is used. This is a development from the batch dryer, the drying chambers being placed end to end in the form of a continuous compartment through which trucks carrying the stock supported on trays, rods or in clips are mechanically propelled at predetermined intervals. The principal features of the three main circulating systems used in tunnel dryers are indicated in the table and shown diagrammatically in Figs. 11 to 14.

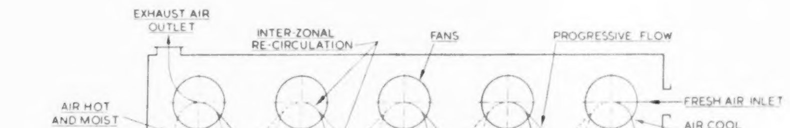


Fig. 14. Tunnel machine with run-about trucks (counter-current air-flow with progressive recirculation)

Theatre at Carborundum

A CERAMICS REPORT

THE official opening on 2nd October of a cinema theatre at the extensive Trafford Park works of the Carborundum Co. Ltd., gave the Company an opportunity to invite members of the Press and other interested friends to a preview of two of the latest additions to an already extensive library of technical films.

After lunch the party were briefly welcomed by Mr. R. G. Snelgrove, general sales manager, and the first film, "The Grinding of a 98 in. Telescope Mirror," was then screened.

Made in association with Sir Howard Grubb, Parsons and Co., and by permission of the Astronomer Royal, the completed film shows the work entailed in grinding and polihsing the 98 in. dia. mirror of the Sir Isaac Newton telescope from a glass disc 18 in. thick, and 5 tons in weight.

The picture gives a clear idea of the value of modern abrasives in a field calling for precision work of the highest order. A first-class effort, the film has sequences well up to Hollywood standards in colour, composition, sound and photography.

The Super Refractories

The second and longer film, "The Super Refractories," is possibly the only film ever made to deal exclusively with industrial heat control. This picture, athough carrying shots of the Company's new silicon-carbide refractories plant at Rainford, Lancs, was made mainly with the co-operation of users of "Carborundum" refractories.

Included are sequences showing refractories of many shapes and kinds at work : gas-heated crucibles at the Royal Mint; kiln furniture in table and sanitary ware potteries; furnace linings in the vitreous enamelling of cast-iron baths; and in the annealing of glass bottles, etc. The accompanying commentary is most instructive; and colour photography has caught wonderfully

An interior view of the new cinema theatre

A still photograph taken during the grinding of 98 in. diameter mirror

well the grandeur of glowing furnace and molten metal.

The Film Production Unit

Both of these films are the script-to-screen work of the Carborundum Co.'s own film production unit, and were made under the direction of Mr. Frank Harris, A.R.P.S., manager, publicity and film department. The unit produces films in many languages for use in Europe and Colonies. Testimony to their quality is implicit in their selection for use by an associated company in America—a fact of which the Trafford Park organisation have good reason to be proud.

The new theatre is capable of seating comfortably at least 200 people, and is equipped with modern projection and sound equipment. It is intended not only for the entertainment of overseas visitors, but also for the instruction of apprentices, visiting societies, and the like.

The afternoon's entertainment ended with a few humorous words of thanks to the visitors for their attendance from Mr. John A. Williamson, managing director.

MAKING THE MOST OF COPPER

IT is now more imperative than ever to obtain expert advice on how to make the most of the copper available to the building industry. The user can always obtain such expert advice and information without charge or obligation by writing to the Copper Development Association. The C.D.A. Building Engineer, Dr. E. Carr, and his assistants, Mr. H. Glover and Mr. S. G. Clements, answer hundreds of enquiries by letter, and if desired visit sites and give practical guidance while work is in progress. Lectures and demonstrations, supplemented by sound films and lantern slides, are given to technical colleges and trade groups. Principals of colleges and secretaries of masters' and operatives' organisations wishing to book such lectures are advised to make early application to the Association.

A Protective Coating for Refractories

WASH coatings of various types over the surfaces of refractory brickwork in attempts to prolong the service life of the refractory have been used for a long time. These washes, made of water mixes of finely-ground lime, fire clay, magnesia or other refractory materials, were brushed or trowelled on the brick, and offered some measure of protection to the refractory for a relatively short period of time.

Within the past twelve years, improved formulæ for coating compounds have been developed and the glazed coatings, known as "Brickseal," have been adaptable to many types of high-temperature equipment such as boilers, incinerators, enamelling furnaces, pottery kilns, gas generators, metal-melting furnaces and various types of steel-treating equipment used for annealing, normalising, tempering, carburising, forging, and similar heat-treating operations.

Grades Available

At present the following grades of these refractory-coating materials are available:

Brickseal Primer however, is a coating which sets at atmospheric temperature and becomes progressively harder as heat is applied being refractory up to 3,600° F. (1,980° C.). The name Primer is a misnomer in that it is not, except on certain applications, used as an under coating. It is a refractory coating designed to withstand severe abrasion and is used by the British Electricity Authority for resisting the abrasion caused when pulverised fuel is used. The only occasions upon which Primer is used as an under-coating for glaze is when it is desired to apply a glaze coating to insulating bricks, certain vermiculite bricks and diatomaceous bricks. If Primer was not used as an under-coating for these types of bricks the glaze, if applied direct, would tend to "soak" in and whilst this would undoubtedly be beneficial it would not in fact leave a glazed surface. By the application of Primer first, however, the glazed coating can be applied after the Primer has been fired and the latter will prevent the glaze disappearing into the brick.

It has not yet been found possible, although research is being conducted, to apply Brickseal Refractory coating to high silica brick.

Refractory coating glaze	*Vitrification temperature* °F.	°C.	*Maximum recommended operating temperature* °F.	°C.
Brickseal Low Glaze (water based)	1,650	900	2,400	1,320
Brickseal High Glaze (water based)	2,200	1,200	2,800	1,540
Brickseal No. 1600 (oil based)	1,500	820	2,000	1,100
Brickseal No. 2000 (oil based)	1,900	1,040	2,400	1,320
Brickseal No. 2600 (oil based)	2,350	1,290	2,700	1,480
Brickseal Coating non-glaze (water based)				
Brickseal Primer air sets at room temperature			3,600	1,980

Each of the first five coatings is made of a mixture of fine-grained refractory clays and metallic oxides, blended in such proportions that the mix fuses to a glaze at its proper vitrification temperature, as given above. It is then serviceable up to the indicated top service temperature. Each grade is a liquid slip of heavy, creamy consistency and may be applied to the refractory surface by ordinary paint brush.

Action Under Heat

As the refractory walls are heated up, the oil vehicle burns out (in the water based coating, the water evaporates) leaving an unbroken coating over the wall, which becomes progressively harder as the temperature is increased. When the indicated vitrification tem-

perature has been achieved, the coating fuses to a soft glaze which is sufficiently plastic to expand and contract with the furnace wall, and withstand considerable abrasion, even when hot.

The refractory coating may be applied equally well to fire clay brick, light-weighted insulating brick, chrome and magnesite, and also to plastic or castable mixes made of the same refractory materials. In the latter case, it is necessary that the refractory wall be well dried out before the coating is applied.

One application of this glazed-refractory coating was to the inside face of the brickwork in a malleable-iron annealing furnace of 20 tons capacity, used in long-cycle heat-treating operations. The operating cycle is about 104 hours from the time of charging to removal of the doors in usual procedure. The furnace was given one coat of a suitable material. The time of cooling has been increased through elimination of air infiltration, which is of considerable value in the annealing of malleable-iron castings, as the grain structure is thereby improved. The heating chamber of this furnace is 20 ft. by 24 ft. by 10 ft. high.

The primary function of a refractory coating is to provide a protective surface which is readily renewed when necessary, to provide a greater overall service life for the underlying refractory. The two principal causes of failure in refractories are spalling and slagging.

Thermal Spalling of Brick

Spalling is the trade term applied to mechanical failure of refractory brick in service and is due, at least in part, to too-rapid heating or cooling of the brick. Three types of spalling are generally recognised: (1) thermal spalling (2) mechanical spalling and (3) structural spalling.

Thermal spalling is caused by localised rapid heating or cooling and is most predominant in applications where operation is intermittent. When a furnace is shut down, the exposed face of the brick cools more rapidly than the interior and it therefore shrinks more quickly than the remainder of the brick. This differential shrinkage sets up tensile and/or shear stresses which, when they exceed the

corresponding strength values of the brick, are relieved by cracks. These cracks often form rather characteristic patterns in various types of brick, sometimes tending to divide the hot face into a number of fairly uniform squares. In other cases, the cracks follow a circular path with the centre of curvature located at a corner of the brick. These cracks usually develop when brick of certain grades cool to a dull red heat (about 1,200° F.), probably because of the volume changes of the silica, which is the predominant mineral in these types of refractory.

Mechanical Spalling

Mechanical spalling occurs when the surface layer of the brick undergoes physical changes which cause it to have a different thermal expansion than the remainder of the brick. These changes may be caused by (a) absorption of fly ash and slag into the pores, (b) melting of the surface layer, (c) selective solution of certain ingredients of the brick by the combustion gases, or (d) crystallisation of the bonding material in the brick. In either case, any change in thermal expansion of the fire-side face of the brick will cause stresses to be set up which may be relieved only by spall cracks, which normally are parallel to the surface.

Structural Spalling

Structural spalling occurs where sufficient space is not allowed for normal thermal expansion, or where too great a load is applied to the refractories. This type of spalling is always suspected when there is a pinching off of the face of the brick to a depth of an inch or two. Structural spalling is almost always due entirely to faulty furnace design and cannot be ascribed to any deficiency of the refractory itself.

Thus, thermal spalling, the type most often encountered, is an inherent characteristic of the brick itself, but the deterioration of the brick in service may be accelerated by structural spalling, which is caused when the expansion produced by a rise in temperature sets up sufficient compression in the wall to cause failure from shearing stresses. A most satisfactory laboratory test to determine the spalling tendency of brick (A.S.T.M. C38-42) combines the effects of thermal and structural spalling. In this test, a panel two bricks wide by seven high is preheated for 24 hours at 2,912° F., then alternated through twelve heating and cooling cycles, with the heat, 2,550° F., applied for 10 minutes at a time. Cooling is done at room temperature, also for 10 minutes, with 2½ gal. of water sprayed on to the panel in the first 8 minutes of the cooling period. At the end of the test, the weight loss is determined and this, expressed in per cent, is known as the spalling loss.

Reduction of Spalling by Coating

This glaze refractory coating is of great assistance in reducing the spalling loss of refractories because, being viscous at the operating temperature, it immediately penetrates any cracks that may develop and acts as a bond to hold the spalled pieces of brick into place. If such a coating were not present, these spalls would fall out of the wall, thereby exposing a new face for later attack. This high-temperature bonding action of the glazed refractory coating is one of its greatest assets, and the panel test on fire clay brick showed an average spalling loss of 17·4 per cent. for the uncoated brick as compared with a loss of only 1·0 per cent. for the same brand of brick coated with Brickseal.

Equally successful results have been obtained in service. For example, in a large food products plant, a pulverised-coal fired boiler, producing 25,000 lb. of steam per hour, had been requiring considerable maintenance to keep the burner rings in proper shape; the rings had to be repaired approximately every four weeks. After the refractory coating was applied, the life of these burner rings was increased to 10 months. Already the material has been supplied to the Electricity Authority and the Gas Boards for the protection of refractories in carbonising, water, gas and boiler installation.

Another application was an optical-glass plant, where the maintenance of refractories in the "glory-holes" had been a troublesome problem. A "glory-hole" is a small cylindrical furnace about 24 in. in length and 14 in. in diameter. Gas-fired, they are operated at 2,450-2,600° F., for re-heating of

optical glass blanks prior to shaping the glass in metal molds. The crowns of these furnaces, made of high-temperature insulating brick, completely failed by spalling after an average life of 6 months. The application of a single coat on the first test trial lengthened the life to 9 months, and a two-coat application gave a total service of 13 months, more than 100 per cent. more than the life obtained from uncoated brick.

One example of a recent Fritt kiln in Britain which was being rebuilt at the Bovey Pottery Co. Ltd., Bovey Tracey, Devon, is of interest. This kiln was in the process of being rebuilt and was treated as follows:

(*a*) Jointing removed to a depth of an inch or more and repointed with Brickseal Bonding Mortar.

(*b*) Heated up sufficiently to drive off moisture in both brick and jointing.

(*c*) Two coatings of Brickseal "Primer" to those parts (bottom and sides) into which the glaze materials come into direct contact.

(*d*) Two coatings of Brickseal High Glaze to the crown and rear end flues.

Treat the fire box where fuel comes into contact, with two coatings of Brickseal "Primer."

The user writes that:

"This work was carefully carried out and the materials found easy of application. The kiln was lit in the usual manner except that we gave it a little longer heating up to the required temperature before commencing the actual period of firing. This period was approximately one week, during which time we dealt with the same quantity of glaze materials as is usual.

"It was a pleasure to note each day the ease with which the 'Fritts' came off. Contrary to our normal experience, not a scrap of the fabric of the kiln came away at any 'running,' so that we had no raking to do and as a result we have a large batch of Fritt in a perfectly clean condition free from foreign matter.

"Since cooling we have examined the kiln and find it to be in a much better state than we have known it to be after once firing for a very long time. The floor appears to be just as it was laid, with joints still good and the whole nicely covered with a smooth coating of glaze. The sides do not appear to be affected at all. The back flues are in excellent condition and the crown, although pickled with stalactites, is quite satisfactory. The new brickwork in the firebox has stood well, although completely clinkered over."

After a second firing the user wrote:

"After a most successful week, we finished as we began, with Fritts running off very easily, and these as free from kiln fabric as could be wished. Quite a welcome change from our experience of recent years and attributable, in our opinion, only to the treating of our rebuilt kiln with your Bonding Mortar and Brickseal in March.

"Normally at this time, that is after

two Frittings, we should need to carry out quite extensive repairs either to the floor, replacing bricks lifted by the seepage of Fritt at the joints or eaten away by the action of the molten mass or to the walls or to both, and certainly to the back flues and feed holes. Today, before speaking to you, I personally inspected the kiln and found that only one or two minor repairs are necessary, involving no more than a couple of dozen bricks.

"The floor has retained its original plane, all joints still sealed, the walls apparently not affected at all, and the crown is intact still carrying innumerable stalactites, but these appear to be composed mainly of clear Fritt. The firebox also is sound and will need no attention.

"It was a very long time ago that this stage was reached with such small damage to the kiln, and as the only manner in which we have departed from our usual method of rebuilding is by using your Bonding Mortar and Brickseals, we can only conclude that it is these materials which have given us the results."

Finally after six firings the user wrote again confirming their satisfaction with the results. Already Brickseal is being used in many of the pottery kilns of North Staffordshire.

Damage on Ships

Two instances of where the use of Brickseal refractory coating has proved valuable to ships which have suffered damage at sea, with the Brickseal holding the boiler setting together, when uncoated bricks undoubtedly would have suffered severe damage are worth noting.

The S.S. Jonathan Edwards, a Liberty ship operated by Griffith Steamship Co. of Seattle, left an Atlantic port, carrying a cargo for a European port. When just 24 hours out of port, the ship suffered a terrific collision which ripped away some of the main plates, allowing the ship to take water to such an extent that 15 ft. of water came into the boiler room. As the ship was operating at full speed at the time of the accident, it is certain that the oil-fired boilers were operating with a temperature of at least 2,400° F., when suddenly flooded with cold sea water.

When, after a great struggle, the ship finally was towed into port, it was found that not a single brick in the boilers was even cracked.

Another marine example concerns the S.S. Alcoa Banner, which in May 1943 was dive-bombed by German attack bombers while in convoy *en route* to Murmansk, Russia. The ship sustained several near misses of heavy bombs, concussion from which was severe enough to loosen rivets, open seams and break lines, light globes and crockery. Due to the heavy concussion, it was felt certain that the boiler brickwork would be found in a heap on the floor of the boilers, and steps were made to provide for relining.

However, when the ship docked at Murmansk one day later, the inspectors found that there was no damage whatever to the refractories.

Slag Attack on Refractories

As stated earlier, slagging is also a major cause of deterioration of refractories. In the broad sense, a slag is any material formed by fusion, but in the refractories field the term usually is applied to waste products which may in one way or another be deposited on the furnace walls, where they react with the refractory.

Obviously, the physical condition of the wall has a great bearing upon its resistance to slag attack. Many types of slag are readily absorbed by the brick; the greater the porosity the more complete the absorption. Any flaws, laminations or cracks allow easy penetration of the slag.

Even if absorption does not take place, a pitted, corroded face offers a much greater total area for chemical attack than does one which bears a smooth, continuous glazed coating. Thus, glazing the wall at once stops penetration of slag into the brick and also minimises the surface area attacked by slag.

Chemical Effects of Slag

On the chemical aspects of slag attack, it should be noted, that the chemical attack may often be minimised by using an acid refractory (one containing an appreciable amount of free silica) against an acid slag, and a basic refractory (magnesia or lime) against basic slags.

The penetration of alkalis, which are present in most fuels, can cause the formation of low-melting compounds which lower the melting temperature of the surface by at least 750° F. Thus, the sodium sulphate present even in high-grade fuel oil can readily combine with the free silica of fire-clay brick to form an intermediate compound which has a melting point much lower than that of the uncontaminated brick. The melting curve of soda-silica mixtures is shown in Fig. 1. The glazed refractory coating, which contains no free silica, provides a mechanical barrier to prevent the alkali from coming in contact with the brick.

Slag action is very severe in boilers where low-grade coal is used, because the slag formed from the ash is a very active flux. If the bricks are not coated, the slag readily penetrates them, then builds up so that the walls must be cleaned down and the tightly adherent slag usually tears off the face of the wall. This trouble may be prevented by using a glazed coating which completely fills the surface pores and presents a hard, smooth surface to which the slag and ash will not adhere firmly. In boilers using this coating, the loosely-adhering ash is now removed in 4 to 6 hours by manipulation of slice bars from outside the furnace, without cooling the boiler down below 1,000-1,200° F. Formerly, the monthly clean-out of such units required a working crew inside the boiler for at least a full day, which meant that the unit was off the line for as long as 3 days. The increase in overall efficiency is significant.

Thus, a glazed refractory coating provides a means of putting a hard, impervious surface, which has high resistance to slag over bricks which are somewhat porous, thus making them better able to resist slagging.

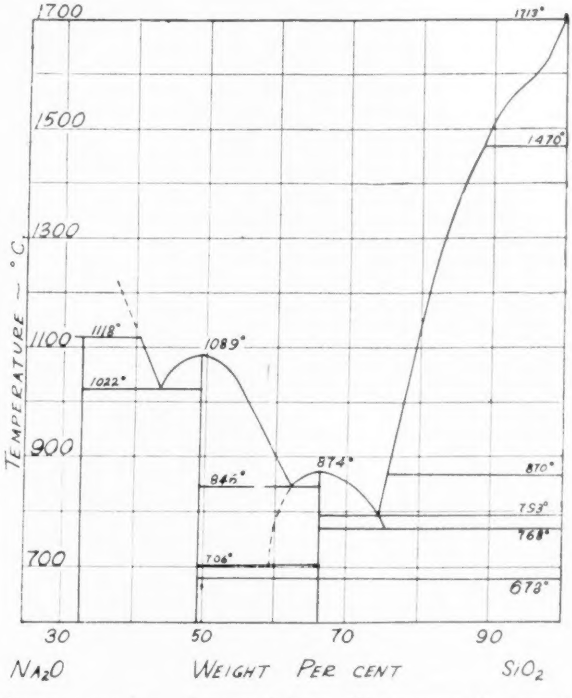


Fig. 1. This equilibrium diagram shows the melting curve of mixtures of soda and silica. Note that the mixture of approximately 74 per cent. silica and 25 per cent. soda has a melting point of only 1,460° F. This explains the slagging caused at low temperatures by the residue of fuel oil on refractory brick

Infiltration of Air

Another very important advantage of glazed coatings is their action in sealing the wall so that no outside air can come through. A practical demonstration of the value of this feature

was noted with a group of periodic 6 ft. by 8 ft. annealing furnaces being used to anneal link pins for tank treads. Because of air infiltration through the mortar joints (even though the bricks were in excellent condition), a majority of the parts had to be annealed through two or three cycles before the required Brinell hardness was obtained. This resulted in a terrific increase in operation cost.

The application of one sprayed coat immediately stopped this infiltration of air, with the result that all of the pieces achieved the proper hardness in one heat-treat operation.

A sealed, vitrified, refractory wall coating is of great operating advantage in all types of steel-treating furnaces, as well as in the checker chambers of glass tanks, metal-melting furnaces and other similar types of high-temperature equipment.

Due to the higher heat reflectivity of a glazed surface, a greater part of the heat is radiated from the glazed wall back into the centre of the furnace. This results in a lower temperature on the outside surface of the furnace wall, and a furnace surfaced with the glazed refractory coating holds the heat much better than one with uncoated walls. In one steel plant, this improved heat retention meant that the periodic heat-treating furnaces could be brought up to their operating temperature of 1,800° F., in 4½ hours after a week-end shut-down, as compared with 6¼ hours before the coating was applied.

Use of Coating Material as Bond

So far use of the glazed material only as a coating on the hot side of the refractory wall has been mentioned. It may also be used to great advantage to replace rigid-setting mortars in laying up such walls, and the lowest temperature grade is normally used for this purpose.

A rigid-setting mortar offers a satisfactory bond between bricks only as long as the distance between the bricks remains unchanged. When the furnace wall is heated, however, unequal expansion takes place in different parts of the wall. This causes the individual mortar joints to increase or decrease in width, thus placing the mortar under tensile or compressive stress, as the case may be. As soon as the strength limits of the mortar are exceeded, the joint is broken and the breathing action of the wall through repeated heating and cooling cycles causes the mortar to be powdered away, leaving a leaky wall, and it sometimes builds up behind the inner wall, causing bulging. If the furnace is operated under positive pressure, heat is lost through the wall; if under negative pressure, cold outside air enters the furnace. In either event, heat losses are unnecessarily high.

These troubles are eliminated by using the refractory coating in place of rigid mortar. The brick may be dip laid, or each course can be laid up dry, then a small quantity of the refractory coating material poured along the top of the row and levelled off with a trowel. The exposed surface of the wall is then covered with the required grade of coating, using either brush or spray gun. When the furnace is brought up to temperature, the material in the joints vitrifies, welding the wall into a monolithic unit, but the individual joints have enough flexibility when hot to accommodate the expansion and contraction of the wall without any failure in the joint. An air-tight wall is maintained at all times.

It is important, however, to ensure that the bricks are of sufficient quality to produce a good face-to-face joint. These days the average quality of fire brick is such, owing to uneven surface, as to proclude this method of bonding bricks.

Operating Advantages

An air-tight wall is of extreme importance in industrial furnaces. The amount of fuel saved, sometimes amounting to as much as 15 per cent., will more than pay for the cost of the glazed refractory coating in many cases. There are, in addition, several other advantages. The furnace may be heated up more quickly, much greater uniformity of heat distribution is achieved throughout the furnace setting, the furnace may be more readily held to the desired time-temperature schedule, and the furnace structure has a much greater mechanical strength.

Brickseal is supplied in this country, most European countries and the Commonwealth by XZIT (G.B.) Ltd., 175 Piccadilly, London, W.1.

TEXTILES IN CERAMIC PRODUCTION

TEXTILES of various kinds, including cotton, silk, jute, nylon, etc., play a most important part in ceramic production. Processes in which they are employed include dust collection, printing, screen decoration, protective clothing and filtration. And it is the latter activity to which these notes are devoted.

In the process of preparing a normal earthenware body, ball and china clays are first blunged with water in separate blungers to given pint weights prior to passing to a mixing ark in required proportion, along with appropriate additions of slop flint and stone.

There the materials are thoroughly blunged together, the resultant slip mixture being passed over a series of phosphor-bronze woven wire-mesh screens ranging from 100 to 160 mesh, as may be required, in order to remove

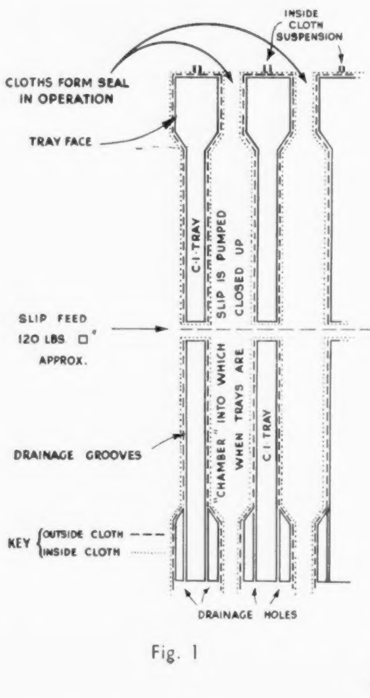


Fig. 1

non-magnetic impurities. The slip is subsequently passed over electro-magnets in order to remove all trace of free iron; and following this the slip is run into a storage ark where it is slowly agitated with the object of preventing settlement of its component materials.

Filtration

The next process is filtration to remove surplus water, and here the slip is pumped to a filter press which consists of a series of cloth-lined cast-iron trays, recessed on either side to an approximate depth of $\frac{3}{4}$ in.

In making ready a filter press a woven jute cloth is first draped over each tray or unit of the press. Thus, the cloth nearest the tray is customarily referred to as an *outside* cloth. Its weight if of the usual jute is about 16 oz. per sq. yard. Such cloths are used to prevent the passing of rust to the actual medium of filtration—the *inside* cloth.

It will readily be understood that rust would contaminate the clay and in addition it is necessary to use an outside cloth for protection of the more expensive inside cloth. The outside cloth is also extremely helpful in making a satisfactory seal when the recessed trays are lightly screwed together prior to operation of the press.

The inside cloth to which reference has been made as the actual filtering medium is usually made of cotton fabric, and is finely woven in order to retain all particles of clay and milled materials embodied in the slip. Such a cloth, while it should be strong enough to withstand pressures of the order of 100-120 lb. per sq. in., must also be open enough in texture to allow water freed in the pressing operation to pass through the yarn of the cloth, and through the interstices of the cloth structure.

As will be gathered from the sketch, when a number of filter trays are placed together a series of air-tight chambers is formed. It is into these that the slip is pumped, the pressure

forcing the water content through inside and outside cloths leaving in each chamber a cake of plastic clay approximately $1\frac{1}{2}$ in. in thickness. The freed water drains away by way of the grooved, recessed tray plates and out through the basal drainage holes provided (Fig. 1).

Time taken in "pressing up," as the operation is termed, varies somewhat and depends on the kinds of clay used, and the quantity of milled material—flint and stone—included in the body composition.

It is, perhaps, noteworthy that the filter presses used in the china clay industry are often gravity fed, whereas with potters slip pumping is standard practice.

Fabrics

The fabrics previously mentioned—jute and cotton—are those which in earlier days were solely in use by the potter. These materials are still used to a considerable extent, but since the war there has been a growing tendency to substitute nylon fabric as the filtering medium. This is due in the main to the resistance of nylon to the attack of mildew.

Mildew takes heavy toll of cotton inside cloths when these are used in the unprepared state, and it is with the object of offsetting such attack that filter cloths are rot-proofed with cupra-ammonium solutions and other mildew deterrents, which to some extent act as preservatives. Unfortunately, however, high pumping pressures and continued use tend to wash out such preservatives, leaving the cloth again liable to mildew attack.

Regular washing of cotton inside cloths, first in warm water to remove adherent clay, subsequently rinsing in a solution of crude carbolic acid—acid 1 pint, water 40 gal.—or, alternatively, in a solution of alum in the proportion of 7 lb. alum to 40 gal. of water will assist in checking mildew before it has too firm a hold on the fabric.

A few pottery manufacturers have been very successful in re-proofing cotton inside cloths with cupra-ammonium with a view to prolonging the life. Such treatment has been found to give excellent results, and "pressing

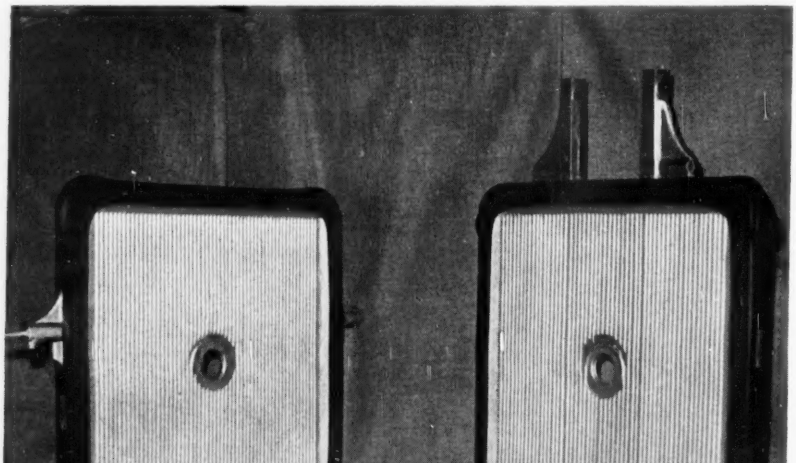


Fig. 2

up" of up to 1,500 fillings per cloth have thereby been obtained.

As already mentioned, the popularity of nylon filter cloths is chiefly due to their complete immunity from the attack of mildew. It follows, therefore, that nylon cloths will have a much longer life than cloths of cotton. In addition, because of its polished surface, a clay or other filtered product is delivered from nylon cloth much more easily than is the case with cotton, and the need for washing filter cloths of nylon is thereby greatly reduced.

When it is necessary to wash nylon filter cloths they should be cleansed only in cold or lukewarm soapy water. This will be found sufficient to clear any "blinding" which may have taken place. It is most undesirable to use hot water for this purpose as it is liable to unbalance the make up of the fabric. Particularly is this so when the temperature of the water used exceeds that at which the nylon fabric was finally set.

Where nylon inside cloths are used it follows that mildew attack is concentrated on the outside cloths, and where an unproofed jute cloth is in use a very short life is usual. It has been found, however, that if proofed jute outside cloths (a cupra-ammonium-treated jute cloth) are used in conjunction with nylon inside cloths, mildew attack is offset and increased cloth life obtained. Up to the present—and while other forms of fabric are on test—a proofed jute cloth has been found to be the most satisfactory cover to use with inside cloths of all types.

Polyvinal chloride (P.V.C.) extruded as a continuous filament and woven into fabric is sometimes used as an alternative to a proofed jute outside cloth, but it does not give such a good seating to the inside cloth. With the P.V.C. outside cloth slightly quicker filtration is obtained, there being not quite so much resistance to the draining of water as with jute. On the other hand, with a P.V.C. cloth runners never make themselves up, and it is impossible effectively to stop blowers once they arise.

A great failing of nylon cloth lies in

(*Continued on page* 437.)

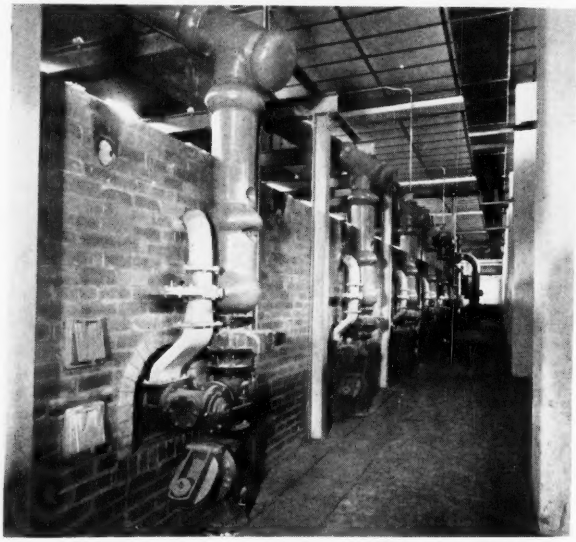
Sanitary bisq kiln, 306 ft. 6 in. long

The "Dressler" Tunnel Kilns at Twyfords Ltd.

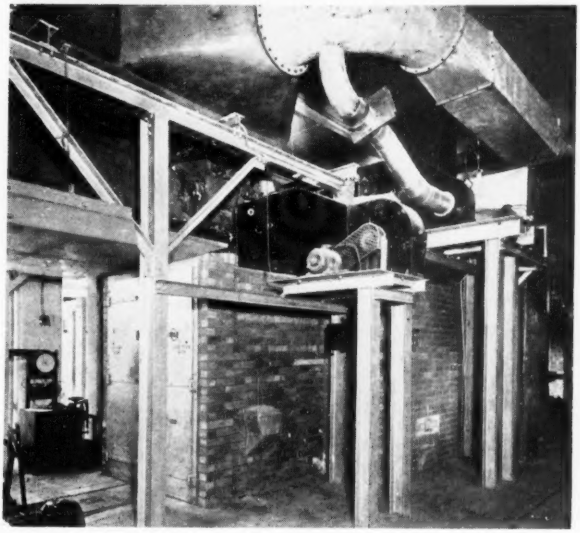
WE learn from Gibbons Bros. Ltd., that the recently developed extension at Twyfords included four kilns, two biscuit and two glost; the two biscuit being set parallel to one another with a passageway about 7 ft. 5 in. between, and similarly for the two glost kilns

Biscuit Kilns

These are 306 ft. 6 in. long overall, containing forty-eight effective trucks



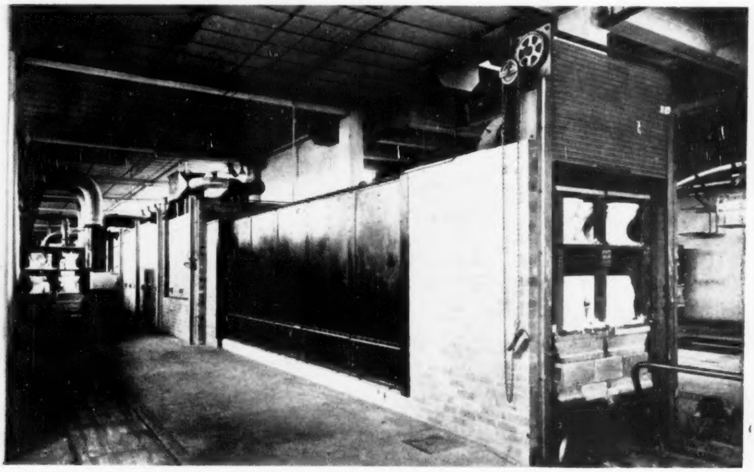
Burner system of Gibbons "Dressler" F.M. tunnel kiln, 300 ft. 4 in. long, firing glost sanitary ware



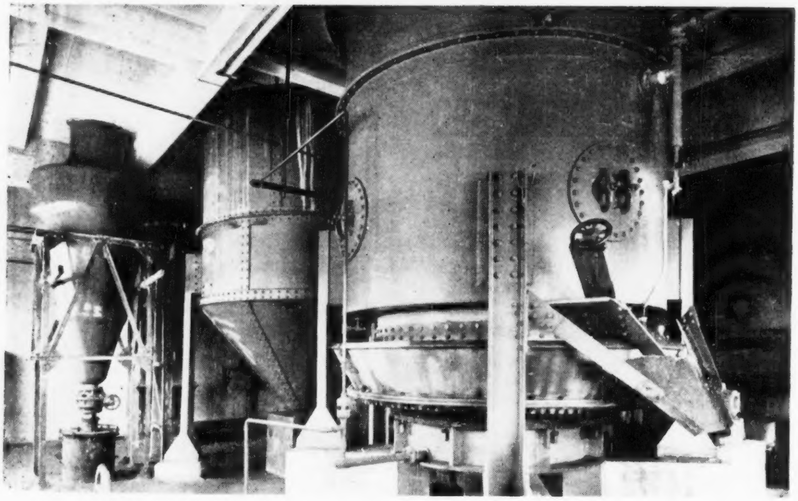
Entrance end of kiln shown below

6 ft. 2 in. long over chassis. Service is one truck every 65 minutes. Firing cycle 52 hours.

The trucks have a loading deck 6 ft. 0 in. long by 4 ft. 6 in. wide by 4 ft. 0 in. high, and approximately thirty-four pieces of sanitary ware are accommodated on the two decks of the truck. The truck chassis are of cast iron fitted with steel apron plates, and they are carried on roller bearings of the sleeved type with mild steel axles and 12 in. diameter wheels. The movement of the trucks through the kiln is continuous, a hydraulic pusher of Gibbons Bros. manufacture being used. This has a bore of 8 in. Working pressure of the pusher is about



Exit end of Gibbons "Dressler" F.M. tunnel kiln



Gas producer unit in connection with the "Dressler" F.M. tunnel kilns

140 lb. per sq. in. and the oil is pumped by a variable stroke oil pump of the Hele-Shaw type submerged in a steel tank, and driven by an electric motor.

The biscuit kiln is fitted with sixteen burners (eight per side) pitched at 6 ft. 2 in. centres, working with towns gas supplied to the kiln at a pressure of about 2 in. w.g. The burners are of the nose mixing type supplied with hot air at a low pressure, this air coming from the recuperator in the case of the No. 1 kiln and from the rapid cooling zone in the case of the No. 2 kiln.

Glost Kilns

The glost kilns are 304 ft. 4 in. long, containing forty-seven effective trucks of identical construction to those on the biscuit kilns. Service is 50 minutes. Firing cycle 39 hours. Load per truck averages thirty-three pieces of large sanitary ware.

The kiln is fired by hot-de-dusted coke producer gas, the de-dusting being carried out in a cyclone dust extractor by Sturtevants. Gas pressure at kiln is 3 in. water gauge.

The burners by Gibbons Bros. are pitched at 10 ft. 0 in. centres, and there are six per side. These burners are supplied with hot secondary air from the rapid cooling zone of the kiln at a pressure of 6 in. water gauge. The burners are of a special type with an adjustable mixing arrangement, and a good flame control can be obtained, the flames travelling longitudinally down the axis of the chambers so that there is no projection of flame directly on to the chamber fronts.

The two glost kilns are also fitted with recuperators as in the case of the biscuit kilns.

Two supplementary towns gas burners are fitted (one per side) for the purpose of maintaining kiln temperature while producer maintenance is being carried out.

General

The four kilns are of very similar construction. They are all fitted with Thrift chamber fronts, which are inclined at an angle of 10° to the vertical, the bottom part of the chamber front which is about 3 ft. 0 in. long being carried by a chamber bottom, while the top is attached to the structure of the kiln by means of a refractory chamber grip. Chamber fronts range in material from silicon carbide and sillimanite to two grades of refractory.

Trucks for the four kilns are of the

two deck type, with silicon carbide decks and fireclay props.

The exhaust gases from the chambers are taken through Newton Chamber needle type recuperators mounted above the kilns, and the hot air thus produced is collected and used for works' heating. Approximately 6-7 per cent. of the heat input to the kiln is recovered from these recuperators.

Instruments

Instruments are by George Kent Ltd. Each of the four kilns is fitted with a large number of pyrometers both in the chambers and in the vault and there are recorders giving 24 hour records of chamber and vault conditions, and in addition, multi-point indicators for periodic readings. There is also a battery of gas flow meters, secondary air flow meters, and other instruments for the measurement of every possible variable on the kilns.

The instruments are grouped on cubicle type panels in a glass sided instrument house near the kilns.

The trucks on the outside lines are kept in constant motion by means of three hydraulic propelling gears to each pair of kilns.

Transfer trucks on the four kilns are of the very latest underslung type which enable the working floor to be level, so that the unsightly transfer truck pits, so prevalent in tunnel kiln installation, are dispensed with.

TEXTILES IN CERAMIC PRODUCTION.— (*Continued from page* 433.)

its tendency to cut and abrade more readily than cotton. This is particularly the case on tray faces. With this problem in mind a rubber surround has been introduced which fits the tray faces, providing an efficient seal between trays, and a rubber seating for the nylon or cotton inside cloth. The surround—Fig. 2—is becoming increasingly popular, and in addition to its other obvious advantages a P.V.C. outside cloth can be used much more effectively with the accessory. The rubber seating eliminates entirely the blower trouble so often experienced with this fabric.

It should be said in conclusion that no hard and fast rules can be laid down regarding the best filter cloths for use in ceramic production. Much depends on the press to be clothed, and on the body content of the slip to be pressed up. Probably the most important point is to choose an inside cloth finely woven enough to give perfectly clear filtration of the material to be treated.

Acknowledgment is made to G. H. Heath and Son, Burslem, for the information contained in these notes.

BRITISH POTTERY MANAGERS' & OFFICIALS' ASSOCIATION

Stoke and Hanley Branch

THE October meeting of the Stoke and Hanley Branch was held in Hanley Town Hall on Monday, 15th October.

Mr. E. T. Mayer was in the chair. He announced that is was hoped to arrange a series of visits to other industries including the plaster industry, the electrical industry, and a firm of brewers.

A visit to the Hanley deep pit was recently made by the Branch and members were taken to the coal face in the course of an interesting tour.

Details of the annual prize offered by the Association were announced by Mr. F. A. Timmins, the general secretary. This prize, in the form of three cash awards, is given for the best essay on any aspect of pottery management, and is open to any student taking the Pottery Courses at the North Staffordshire Technical College. Dr. H. W. Webb, O.B.E., D.Sc., F.R.I.C., M.I.Chem.E., has very kindly agreed to act as adjudicator.

The above item was of special interest as the meeting concluded with a talk given by Mr. A. H. Thompson who was the first-prize winner in last year's competition. The talk he gave was on "Science in management" and was based on the essay with which the prize was won.

The talk was very well received and many questions were asked and answered before a vote of thanks to the speaker was proposed and seconded at the conclusion of the meeting.

VITREOUS ENAMELLING STEEL STRIP

Our American Correspondent

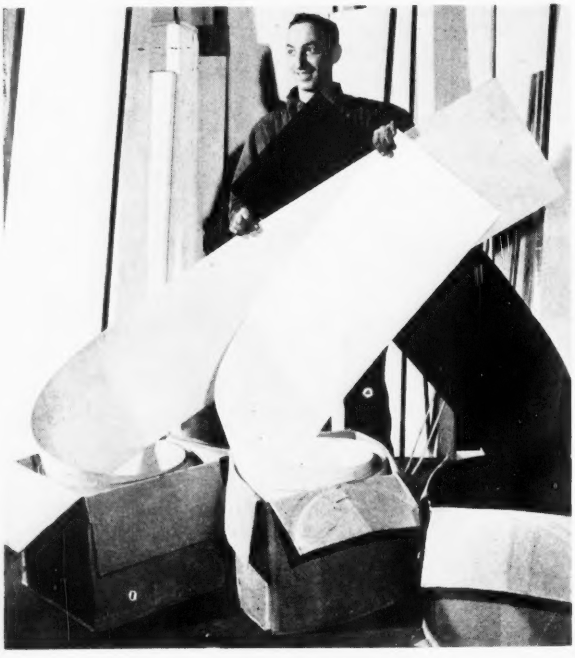
THE Baltimore Porcelain Steel Corporation has recently developed an entirely new product, called "Mirawal." It is described as "porcelain on steel" and is so flexible that it can be rolled into coils with a minimum radius of 6 in. without damage to the material.

It is manufactured by taking a coil of 32 gauge (010) steel and coating it continuously without cutting it into short lengths.

At the mill, a coil of steel is precleaned and is placed on a rack that is located at one end of the line. A nickel flash is given to it in the form of a solution of single nickel salt-strength of 12 oz. per gallon—passing then through an infra-red lamp drying system to reach the first set of drive rollers. From there, it follows its way through a ground coat spray booth, where a soft ground coat is being applied on both sides of the steel sheet of "two thousandths" (0·002) thickness.

Next step is the ground coat furnace, where the sheet is fired at 1,560° F. The sheet emerges from the furnace and travels through the second set of drive rollers located immediately ahead of the finish coat spray booth. (Here the sheet is being suspended in an arc between the two sets of rollers.) The tension is so great on the two sets of rollers that the steel does not rest on anything between them.

Then, from the second drive, the



"Porcelain on steel" is an extremely flexible material and is guaranteed for life against cracking, crazing or colour fading. It is easy to clean and never requires "re-finishing"

steel sheet goes through another spray booth where acid-resisting titanium cover coat is applied to both sides of the sheet at a thickness of four thousandths (0·004).

Next, it reaches the second furnace where the coat of finish is fired at 1,560° F. then travels to a third set of drive rollers. After this the coated sheet is inspected, cut into 100 ft. lengths and finally coiled for shipping.

The finished coated sheet's total thickness is twenty-two thousandths in. (0·022) out of which ten thousandths is of steel and six thousandths is of porcelain coating on each side of the steel sheet.

THE BRITISH CERAMIC SOCIETY

Refractory and Building Materials' Sections

THE Autumn Meeting of the two sections will be held in London and Colchester. The technical sessions will be held on Wednesday afternoon, 7th November, and Friday morning, 9th November in the rooms of the Royal Sanitary Institute, 90 Buckingham Palace Road, London, S.W.1. The meeting on Thursday, 8th November, will be at Colchester when the works of Moler Products Ltd., manufacturers of heat insulating products, will be visited.

The programme for the technical session is as follows:

Wednesday, 7th November, 1951

The Refractory Materials Section will meet in the library of the Royal Sanitary Institute. Chairman: the president, Dr. J. H. Chesters.

2.15 p.m. Meeting of the Section Council.

2.45 p.m. General Business Meeting of the Section.

3.00 p.m. The following papers will be presented and discussed:

(1) "The Ternary System Al_2O_3—TiO_2—SiO_2" by Mr. Y. M. Agamawi and Dr. J. White.

(2) "The Constitution of Refractory Clays."

(a) "The Determination of Mineral Constitution" by Mr. R. W. Grimshaw and Professor A. L. Roberts.

(b) "The Constitution of Some Yorkshire Fireclays" by Mr. K. Carr, Mr. R. W. Grimshaw and Professor A. L. Roberts.

(c) "The Relationship between Constitution and Properties with Special Reference to the Influence of Micaceous Minerals" by Mr. K. Carr, Mr. R. W. Grimshaw and Professor A. L. Roberts.

The Building Materials Section will meet in the committee room of the Royal Sanitary Institute. Chairman: M. S. Whitehouse, Esq., M.B.E.

2.15 p.m. Meeting of the Sectional Council.

2.45 p.m. General Business Meeting of the Section.

3.00 p.m. The following Papers will be presented and discussed:

(1) "Bricks and Clays of the Hastings Beds" by Mr. B. Butterworth and Mr. D. B. Honeyborne.

(2) "Some Possibilities of Scientific Control in the Heavy Clay Industries" by Dr. G. H. Whiting.

Friday, 9th November, 1951

A combined session of the Refractory Materials and Building Materials Sections will take place in the library of the Sanitary Institute, the president taking the chair.

10.00 a.m. The following papers will be presented and discussed:

(1) "The Production and Distribution of Steam with Special Reference to the Ceramic Industries" by Mr. E. Griffiths.

(2) "The Preparation and Processing of Clay in the Heavy Clay Industries" by Mr. J. S. Jones.

1.00 p.m. Close of the Autumn Meeting.

ARBITRATION

WE have received from W. Heffer and Sons Ltd., Cambridge, a copy of a booklet on "Arbitration" which has a particular interest because it was written by that old friend of the gas industry, J. R. W. Alexander. On this occasion Mr. Alexander almost dons his wig, although he will probably deny this, because he reminds us on the title page "An arbitrator has regard to equity and the judge to law . . . Aristotle." None the less Mr. Alexander with his usual care for detail has within 24 pages presented a very knowing appreciation of the rules, motives and so on of arbitration.

Actually this is a publication by the Chartered Institute of Secretaries through Messrs. Heffer, and copies can be obtained from either the Chartered Institute at 16 George Street, London, E.C.4, or W. Heffer and Sons Ltd., Cambridge. And most assuredly anyone who is interested in arbitration in its many aspects should study this booklet, for Mr. Alexander is somewhat an authority on this matter—with a legalistic background. The price is 2s.

A REFRACTORY ENAMEL

For the Protection of Mild Steel against the effects of High Temperatures

UNPROTECTED mild steel is not suitable for long periods of use in an oxidising atmosphere at temperatures above 500° C. It has hitherto been necessary to resort to heat-resisting steel in cases where a material having the mechanical properties of mild steel is to be used at temperatures much in excess of that figure, and as the cost of heat-resisting steel is about twelve times that of mild steel, and in addition the fabrication of articles from heat-resisting steel is usually considerably more difficult than from mild steel, the resulting article is much more expensive.

During the war a method of upgrading mild steel was developed and used with success for the protection of the mild steel exhaust pipes fitted to the Rolls-Royce engines of Spitfire and Mosquito aircraft.

Since the war the process has been improved and several applications which may be of interest are mentioned in this report.

The Process

The latest finish known as "Stoneclad" was developed by Matthews Refractories Ltd., Paisley Works, Swains Road, London, S.W.17, and is applied by Stewart and Gray Ltd. of the same address. It is designed to protect mild steel or cast iron from corrosion at high temperatures and to permit their use in many instances where heat-resisting steel would otherwise be called for, an exception is where the high temperature is accompanied by considerable stress. It consists in carrying, in a boro-silicate matrix, a suspension of insoluble refractories and bonding it to the metal surface by fusion at about 800° C.

The treatment may be a single homogeneous coat approximately 0·004 in. thick where resistance to oxidation only is required, or it may be in two coats, the upper being more refractory than the lower, porous, and 0·020 in. to 0·060 in. thick.

The properties of the coating depend on the proportions of refractory to matrix, the particle size, the number of layers present, and the porosity of the upper face. It is always non-porous at the metal interface.

Applications

The process has been applied successfully to the emitting surface of black emitter radiant heaters both of those used for space heating and for industrial heating processes.

In a heater of the latter kind in which a black mild steel sheet is heated by the products of combustion from a bar burner at the bottom of the combustion chamber formed between the steel sheet and a slab of insulating material, a baffle plate is fitted behind the radiating surface in order to shield the lower part from overheating due to direct exposure to the products of combustion and radiation from the flames and insulating slab. The panel temperature of this appliance was originally limited to 650° F. because, at that temperature, the baffle plate was at about 500° C. (932° F.) above which it is not advisable to heat mild steel for long periods if scaling is to be avoided.

The radiant panels and baffle plate of these appliances are now protected by the Stoneclad process, the finish of the panels being smooth and black or dark grey in colour, its

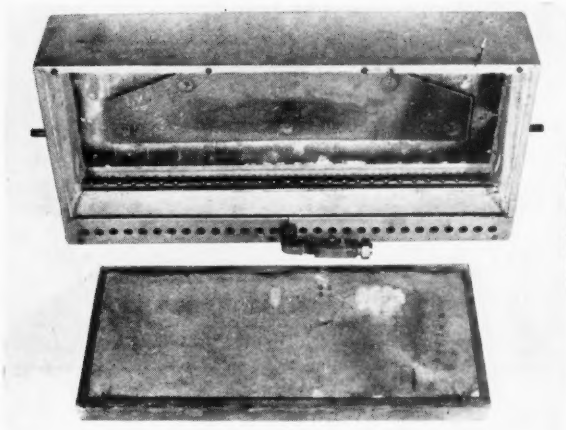


Fig. 1

purpose being to prevent rusting and to be and remain of good appearance, while the baffle plates have a comparatively rough, biscuit coloured surface brought about by the inclusion of a higher proportion of refractory material and resulting in a greater resistance to high temperatures and thermal shock.

Test Results

The heater having the panel and baffle plate protected by this process has operated for a period of 5,000 hours at a panel temperature of approximately 850° F. (454° C.) at which the baffle plate is about at 620° C.; on occasions, however, the panel temperature has been as high as 890° F. and the baffle temperature 690° C.

The high panel temperature attained in these tests was the result of doubling the normal heat input of the appliance while the panel was radiating on to the surroundings at approximately room temperature. At the conclusion of this test the baffle plate had buckled a little and there were small patches at several points near the edges where the refractory surface had broken away. In addition there were small deposits of a powdery substance on both the

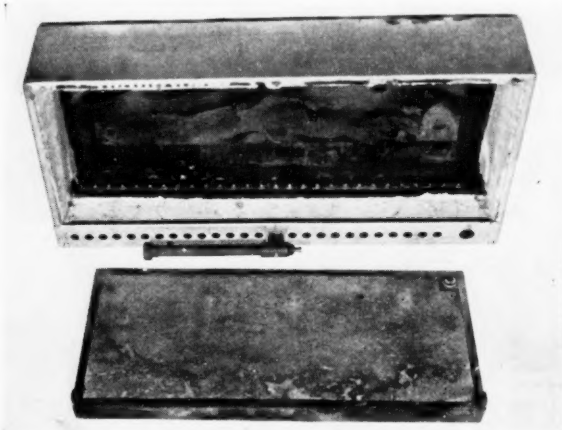


Fig. 2

baffle plate and panel but from the general appearance of the protective coating, the baffle plate was still in good condition.

Fig. 1 and 2 respectively show views of the baffle plate and panel of the appliance mentioned in the foregoing paragraph, after 1,700 hours heating, and the unprotected mild steel baffle plate and panel of a heater operated under identical conditions. It will be seen in Fig. 1 that some discoloration has occurred while in Fig. 2 large pieces of scale are seen to have broken away from the baffle plate, some of which had resulted in incomplete combustion.

The tests on the unprotected baffle plate were concluded at that time because the scaled condition of the mild steel was having an adverse affect on the performance of the appliance and it was felt that the material had, therefore, failed. Further heating would result in the formation of more scale which would again lead to incomplete combustion and eventually the baffle plate would be corroded away completely.

On the other hand, there was no appreciable change in the appearance of the protected baffle plate between the time when it was photographed after heating for 1,700 hours and when examined after heating for 5,000 hours. This heater is still running under the same conditions and after more than 7,000 hours it is still operating satisfactorily.

It was found that the emissivity of this finish is, at the temperature involved in the radiant heaters to which it has been applied, of the same order as that of black mild steel.

Apart from the above application, it is used on a number of space heating appliances and a finish similar to that used for the protection of baffle plates has been applied with success to a fabricated mild steel mixing chamber, used in connection with some experiments in which products of combustion at about 800° C. passed through a central tube while comparatively cool recirculated gases were fed into the annulus surrounding the tube before being mixed with the hot gases. Under these conditions unprotected mild steel components had a life of but a few hours, whereas the upgraded mild steel appeared to be in its original condition at the conclusion of the the experiments.

The smooth finish as applied to the panels of radiant heaters is claimed to be suitable for use up to a temperature of 670° C. and the more refractory finish applied to the baffle plates up to 800° C.

The use of this finish has given encouraging results in the applications mentioned and it is suggested that there may be many instances of high grade heat-resisting steels being used where temperatures of 500° C. to 800° C. are encountered in which mild steel protected by this process would be satisfactory.

METAL CLEANING

MERCOL PRODUCTS LTD., Eyre Lane, Sheffield 1, have distributed a leaflet dealing with their various metal cleaning products. Among them is "Mercol D-G" compound which is a quickly soluble powder used in tanks.

As an example of its effectiveness it is claimed that a ball race can be cleaned in five minutes, an air filter in ten minutes. Another interesting application is the circulation of the degreasing material through the air, oil or steam passes of engine units. A useful table gives the size and length of pipe for heating.

Reference is made to the "Mercol Solvent Degreaser S-D-G" which can be applied by immersion, brushing or soaking whilst "Mercol S-G-B" is a special preparation for removing carbon deposits from flame traps or diesel locomotives.

H. C. Reeves.—Mr. H. C. Reeves, B.Sc.(Eng.), A.M.Inst.C.E., D.I.C. has been appointed chief fan designer of Air Control Installations Ltd.

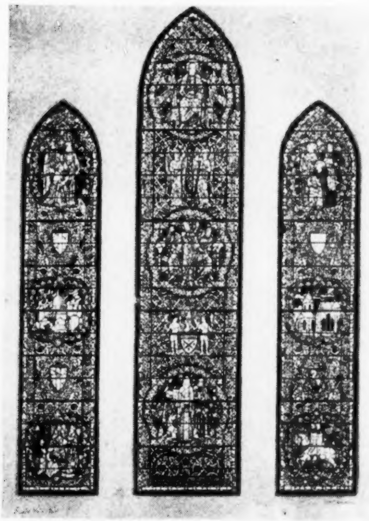
Constructors Ltd.—Mr. H. P. Williams has been appointed buyer for Constructors Ltd., Tyburn Road, Erdington, Birmingham 24.

TEMPLE CHURCH—THE GREAT EAST WINDOW

THE window, designed by Mr. Carl Edwards chief designer at the Whitefriars Glass Works of James Powell & Sons (Whitefriars) Ltd., to replace the Great East Window of the Temple Church was seen by the Lord Mayor of London (Alderman Sir Denys Lowson) when he paid a special visit to the works for this purpose recently.

The new window, which will consist of three lights, the centre being 21 ft. high and 4 ft. 6 in. wide and those at either side 17 ft. high by 3 ft. 4 in. wide is to replace the ancient window destroyed in the blitz. Mr. Edwards' design which was selected from a number submitted to the Worshipful Company of Glaziers and Painters of Glass employs a deep and wide range of colours, the use of many unusual tints being made possible by the fact that the Whitefriars studios make all their own glass according to requirements under the direct supervision of the designer and the cutter. In his use of colour the designer has gone back to the earlier methods of his craft, and the new window can be said to be fully in keeping with the tradition of the building which it is destined to enrich.

The bowl presented to Sir Denys Lowson on the occasion of his visit to the Whitefriars Glass Works



Our photograph shows the design of the new window

Work on the window was commenced about 4 months ago and fitting is expected to begin later this year. The Lord Mayor saw the main part of the centre light erected in a darkened window frame and portions of the other lights being fitted with lead glazing bars on the bench. The completed window will consist of at least 15,000 pieces of glass, each specially chosen for colour and specially cut. The total weight will be just over 1 ton.

The theme of the window design is "The Law and The Order of the Temple" and the traditional medallion style is employed. The window achieves an effect of jewel-like brilliance and although the leads used vary from half-an-inch to one inch in thickness, they do not appear heavy, due to the height of the window above the floor.

Sir Denys Lowson photographed during his visit to James Powell and Sons (Whitefriars) Ltd.

The Presentation Bowl

Before touring the works the Lord Mayor, who was accompanied by Sheriff P. T. Lovely, a member of the Company of Glaziers and Painters of Glass, was presented with a bowl of diamond engraved lead crystal by Sir Graham Cunningham, K.B.E., chairman of James Powell and Sons (Whitefriars) Ltd., who asked Sir Denys Lowson to accept the bowl as a souvenir of his visit. This example of hand-made table glassware is to the design of Mr. W. J. Wilson, director and general manager. The diamond engraving which decorates the bowl was carried out by Mr. Wilson using a process revived by him in 1935, after nearly two centuries. Until this revival the only known diamond engraved glassware was in museums or the hands of antique collectors. It still remains a rare process although it produces a finer, more delicate effect than the more usual copper wheel engraving method.

Among the guests of James Powell and Sons (Whitefriars) Ltd., who accompanied the Lord Mayor on his tour of inspection were the Marquess of Carisbrooke chairman of the Stained Glass Committee of the Worshipful Company of Glaziers and Painters of Glass, Mr. Frank O. Salisbury the well-known artist, Mr. C. D. Roberts, K.C., Master of the Company and Prebendary A. J. Macdonald representing the Master of the Temple.

This window is to be given to the Temple Church by the Worshipful Company of Glaziers and Painters of Glass of which the designer is a Liveryman.

BRITISH CERAMIC SOCIETY

IN Vol. 50, No. 9, September, 1951, of the Transactions of the British Ceramic Society appear the following papers: "Contribution to the Study of Sillimanite, and Mullite by X-rays," by W. L. de Keyser; "Miniature Scale Equipment for Ceramic Experimental Work," by I. C. McDowall and W. Vose; "Experimental Firing in a Small Multi-passage Kiln," by W. L. German.

THE HAMMOCK IDLER

OUR illustration shows the hammock idler (provisional patent No. 24796/49) which is a type of belt support, the design of which enables the belt to adopt its natural curve when loaded with material. The trough is dependent upon the quantity carried and can be adjusted for materials with different specific gravities. The adjusting trough decreases the spillage and the design is such that any tendency of the load to be on one side of the belt is quickly corrected.

The rubber tube roller is designed to stand up to abrasive material and continual flexing due to variation in load. Although all impact due to heavy loads is easily absorbed, the idler is not intended for heavy duty at loading and transfer points.

The design leaves a clear space beneath the roller to allow for cleaning and to prevent building up of material. In case of accident or damage to the idler the likelihood of belt damage is lessened and replacement of the idler is easy. The hammock idler is suitable for all belt widths and may be fitted to existing installations.

The hammock idler (prov. pat. 24796/49) is manufactured by Richard Sutcliffe Ltd., Universal Works, Horbury, Wakefield

BRITISH STANDARDS

FROM the British Standards Institution Monthly Information Sheet for May, 1951, the following revised standards are extracted.

B.S. 65 : 1951. Salt-glazed ware pipes including junctions, tapered pipes and bends and half-section channels, tapers, bends and junctions.

Sets out the full dimensions for pipes, bends and junctions and half section channels covering the same range. Tolerances on dimensions and the tests to be applied for general quality, hydraulic soundness and absorption are given and the method of making is also covered. (Price 3s.)

B.S. 539 Part 1 : 1951. Dimensions of drain fittings. Salt-glazed ware and glass (vitreous) enamelled salt-glazed fireclay.

Gives the standard sizes and dimensions for the following range of fittings:

Channel interceptors. Branchbends. Traps with raising pieces. Gullies. Round street gullies. Grease and mud gullies. Hoppers. (Price 5s.)

B.S. 539 Part 2 : 1951. Dimensions of drain fittings—Scottish type. Salt-glazed ware and glass (vitreous) enamelled salt-glazed fireclay.

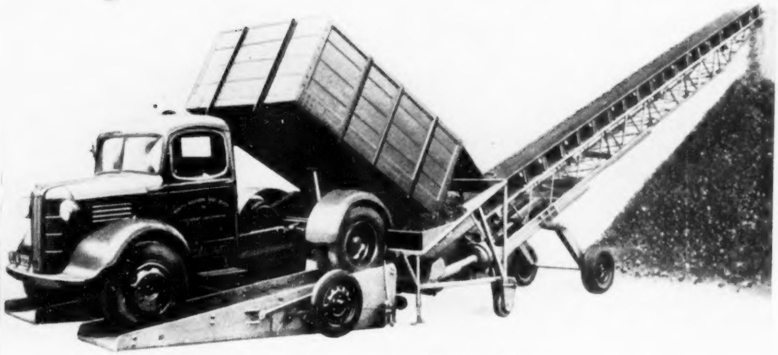
Gives the standard sizes and dimensions for the following range of fittings for use in Scottish practice:

Access pipes. Access bends. Range of single, double and triple access branches available either with curved or angled branches. Buchan traps. Low-back traps, S.R.A. tops. Hart tops. (Price 2s. 6d.)

B.S. 540 : 1951. Salt-glazed, glass (vitreous) enamelled fireclay pipes.

Sets out the full dimensions for pipes, bends and junctions and half section channels covering the same range. Tolerances on dimensions and the tests to be applied for general quality, hydraulic soundness and permeability are given and the method of marking is also covered. (Price 3s.)

The address of the Institution is 24 Victoria Street, London, S.W.1.



The Hylo-veyor ramp loader combination

HYLO-VEYOR RAMP LOADER

MOBILE equipment is now available, through C. H. Johnson (Machinery) Ltd., to take the discharge direct from end tipping lorries and form stockpiles up to 20 ft. high, consisting of a Hylo-veyor, special portable wide hopper, and a mobile ramp.

The hopper is wide enough to take all widths of lorry and is mounted on four pneumatic wheels, two of which are fitted to the swivelling axle, which is complete with a steering arm. This hopper straddles the bottom section of the Hylo-veyor and is designed so that the conveyor can operate from horizontal to maximum discharge height to eliminate breakage of material.

The mobile ramp consists of two troughs of chequered plate of sufficient width to accommodate all lorry wheels. These troughs are 12 ft. long, being braced together and supported in a braced structure which gives a vertical height of 2 ft. at the back of the troughs. The side plates to the troughs are splayed out at the bottom end to give a certain amount of guidance to the lorry wheels. The complete machine is mounted on two pneumatic wheels, which are attached to pivoting brackets fixed to the structure. These brackets are in turn attached to two hydraulic jacks operated by one hand pump mounted on the machine. When the ramp is in the operating position the wheels are retracted and the ramp sits on its base. To move the ramp, the jacks are pumped up, lifting the machine clear from the ground, when it can be easily moved around by a hand bar fixed between the troughs.

ADVERTISERS' INDEX

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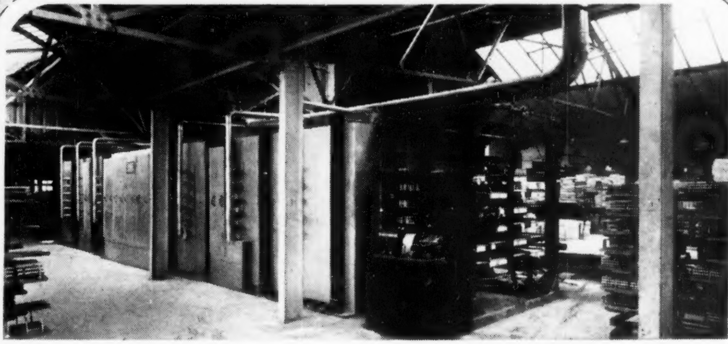

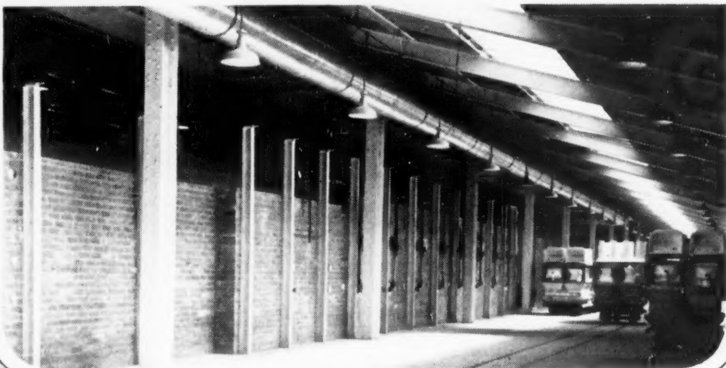

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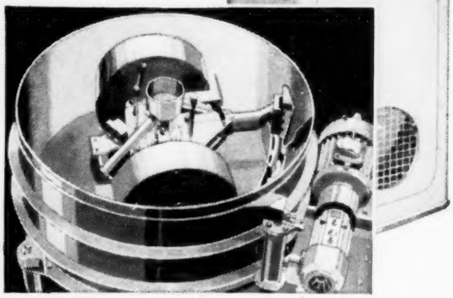

Inset picture shows the No. 2 size with mullers (adjustable for height from bottom of pan) and the plows which turn over the material and direct it in front of the mullers. The Hood (not shown) supplied as standard for all ceramic installations.

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